

PROTECTING CORAL REEFS: THE PRINCIPAL NATIONAL AND INTERNATIONAL LEGAL INSTRUMENTS

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It is time humankind stopped abusing the generosity of the ocean, wellspring of Earth's life-support system.¹

I. INTRODUCTION

Coral reefs are dying at an alarming rate. Millions of people depend on coral reefs for their sustenance and livelihood, yet these vital resources may soon be lost. The current legal protections for coral reefs are often inadequate or unenforced, and the world community must take immediate measures to halt the current devastation. In the United States, President Bill Clinton responded to the crisis with a series of executive orders intended to protect coral reefs. It remains to be seen whether President George W. Bush and the Congress will continue and expand on these efforts. The international community also began to address the crisis in the last decade, but only time will tell if its actions are enough to stave off the large-scale disappearance of coral reefs.

While there exists a wide array of local, state, national, and international initiatives that attempt, in varying degrees, to protect and preserve these ecosystems, this Note focuses on the principal U.S. national and international legal instruments that may provide for coral reef protection.²

Part II of this Note explains the importance of coral reefs to humans and the human-caused threats to reef ecosystems. This Part also describes

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¹ Sylvia Earle, *The Sea and Its Treasures*, UNESCO COURIER, July 1998, at 22, LEXIS, Nexis Library, UNESCO File.

² This in no way diminishes the importance of locally based initiatives, which in the end may be the most sustainable approach to ecological problems. However, given the limitations of one article, I have chosen to consider programs with the widest possible application. See, e.g., RODNEY V. SALM & JOHN R. CLARK, MARINE AND COASTAL PROTECTED AREAS: A GUIDE FOR PLANNERS AND MANAGERS 65 (2001) (noting the efficacy of some traditional fisheries practices prior to the advent of Western colonialism, the authors state, "it has become obvious that coastal resources conservation benefits from decentralization of authority. . . . The approach . . . succeeds because empowering communities always works better than commanding them."); see also CHARLES BIRKELAND, LIFE AND DEATH OF CORAL REEFS 383 (1997).

the condition of coral reefs and the difficulty in understanding their perilous situation. Part III analyzes the delicate balancing act between human use of natural resources and conservation efforts. Part IV examines efforts in the United States to preserve coral reefs and potential sources of legal assistance for reef conservation. Part V looks at international laws that currently address coral reef preservation and other conventions that could be used to protect reefs. The final two Parts set forth recommendations for increased legal protections for coral reefs in light of the crisis that confronts the existence of reefs across the world.

II. THE RAINFORESTS OF THE SEA

Few people have ever had the privilege of seeing a coral reef in its natural setting; fewer still have seen a truly pristine reef. Of those who do encounter a reef, most have no idea that what they are witnessing may be gone in a few decades, as illustrated by the following account of a typical trip on a dive boat in the Florida Keys:

The reef looked like a field of vaporized boulders—a white film covering the scene of destruction. Occasionally, a lone parrot fish darted around a single sea fan, or even a small school of sargent majors zipped by. But the scene was bleak. On the way back to Key West, the honeymooners and college students on spring break were raucous; the crew kept their beer glasses filled. The novice snorkelers jabbered excitedly about the wonders of the sea. “Did you see that orange and white striped one!” they exclaimed. Or, “what about that purple fan-shaped thing?” Since this was their first time snorkeling, most of them were unaware that what they saw was but the remnants of a once-glorious reef, and no one from the crew was about to make them any wiser.³

This account highlights a common behavioral problem in observing the outside world. When blinded by the radiance of the present moment, one tends to believe that what one sees is presently in its finest state. Among scientists this phenomenon is known as the “shifting baseline syndrome.”⁴ Biologist James Carlton has pointed out that “[w]ithout a framework of study and a deeper appreciation for marine environmental history, our sense of history often defaults to viewing the step on which we are standing as the second step of the staircase, no matter how far

³ Author’s personal narrative, Florida Keys (Jan. 1998).

⁴ James Carlton, *Apostrophe to the Ocean*, 12 CONSERVATION BIOLOGY 1165, 1166 (1998).

down the staircase we have gone.”⁵ For lay persons, a trip to a coral reef today is like viewing an endangered species in a zoo cage, but without the explanatory notice telling us that this beautiful creature may soon be extinct.

A. What Are Coral Reefs?

To the untrained eye coral reefs may look like a bunch of rocks, but they are actually extremely complex ecosystems of plants and animals that occur primarily in shallow tropical waters.⁶ The process of reef formation occurs over hundreds or even thousands of years.⁷ This slow replacement rate is one reason why the current rapid rate of reef decline is so ominous.

Coral reefs are distributed throughout the world in the coastal waters of 101 countries and territories, yet they make up only one-tenth of one percent of the total ocean area.⁸ Worldwide, they occupy just 284,300 square kilometers, an area about half the size of France.⁹ Yet this tiny zone is home to approximately one-fourth of all marine species.¹⁰ Since underwater exploration and marine science only recently began to de-

⁵ *Id.*

⁶ See MARK SPALDING ET AL., WORLD ATLAS OF CORAL REEFS 15 (2001).

[R]eefs are typified by the presence of large stony corals growing in profusion and by an often bewildering array of species growing or moving among them. . . . They are almost entirely confined to areas of warm, shallow water, and it is their skeletons, essentially built of limestone, which are critical to the formation of coral reefs. . . . Over centuries or millennia the active growth of these corals (alongside other organisms such as coralline algae, which also lay down calcium carbonate skeletons) leads to the building up of vast carbonate structures. . . . In this way a coral reef is built. Only a tiny fraction of the growth of individual corals is converted into upwards development of a reef structure, and so their formation takes place over geological time scales. The most rapid periods of reef “growth” have shown upwards accumulation of reef structures reaching 9–15 meters in 1000 years in some areas, but much lower figures are probably more normal. . . . Reef-building corals are highly dependent on a symbiotic relationship with microscopic algae (zooxanthellae) which live within the coral tissues.

Id.

⁷ See *id.*

⁸ Press Release, United Nations Environment Programme-World Conservation Monitoring Centre (“UNEP-WCMC”), New Atlas Maps the World’s Fast Disappearing Coral Reefs (Sept. 11, 2001), available at http://www.unep-wcmc.org/marine/coralatlas/PRESs_RELEASE.htm [hereinafter UNEP-WCMC] (on file with the Harvard Environmental Law Review). Fringing reefs, barriers reefs, and atolls are the three types of coral reefs. Fringing reefs occur near coasts. Barrier reefs, such as Australia’s Great Barrier Reef, are separated from the coast by a deep lagoon. Lastly, atolls are rings of reefs around lagoons such as found around many Pacific islands. France Bequette, *Coral: Taking the Pulse of the Planet*, UNESCO COURIER, July 1994, at 53–54.

⁹ *Id.*

¹⁰ Julia Whitty, *Shoals of Time*, HARPER’S, Jan. 2001, at 58.

velop with the advent of scuba diving,¹¹ scientists do not know how many species are housed in coral reefs.¹² Estimates of individual coral reef species range from one to nine million.¹³ There are more than four thousand species of fish alone on coral reefs.¹⁴ Consider a writer's description of the awesome variety of life on coral reefs:

On a single coral reef surrounding one tiny Australian island, there are one thousand known species of fishes. Zoom in closer: a scientist has counted 620 species of shrimp living on corals. Get even closer; go inside the coral: there, searching through labyrinth of passageways within a single colony, an investigator found 103 separate species of a single kind of worm.¹⁵

Only tropical rain forests rival coral reefs in terms of their diversity,¹⁶ though rain forests cover twenty times more area than reefs.¹⁷ We are now all aware of the importance of our tropical rain forests, and it is time we focused as much attention on coral reefs, whose incredibly vibrant ecosystems are also in danger of being destroyed.

B. The Importance of Reefs to Humans

The death of coral reefs could have disastrous consequences for both human and marine life. Billions of people depend on coral reefs in one way or another. Coral reefs provide food and wealth—from the fish that thrive in their shelter, to tourism, to the harvesting of corals, shells, and tropical fish.¹⁸ One-fifth of all protein consumed by humans comes from marine environments, and one billion people in Asia alone depend on reefs for their food.¹⁹ Reefs all over the world protect shorelines from hurricane waves and serve as breakwaters for islands.²⁰ Scientists are increasingly finding biomedical applications for reef organisms, ranging from antidepressant drugs to the use of coral in repairing bone breaks.²¹

¹¹ SPALDING ET AL., *supra* note 6, at 9.

¹² UNEP-WCMC, *supra* note 8 (reporting that “only about ten percent of [coral reef] species have been described by scientists”).

¹³ MARJORIE REAKA-KUDLA ET AL., BIODIVERSITY II 93 (1997).

¹⁴ BIRKELAND, *supra* note 2, at 303.

¹⁵ OSHA GRAY DAVIDSON, THE ENCHANTED BRAID: COMING TO TERMS WITH NATURE ON THE CORAL REEF 5 (1998).

¹⁶ SPALDING ET AL., *supra* note 6, at 9.

¹⁷ REAKA-KUDLA ET AL., *supra* note 13, at 88.

¹⁸ Interview with Robert Ginsburg, Professor, Rosenstiel School of Marine and Atmospheric Sciences, in Miami, Fla. (Jan. 27, 1998) (notes on file with the Harvard Environmental Law Review).

¹⁹ DIRK BRYANT ET AL., REEFS AT RISK: A MAP BASED INDICATOR OF THREATS TO THE WORLD'S CORAL REEFS 9 (1998), available at <http://www.wri.org/indctrs/pdf/reefs.pdf>.

²⁰ Interview with Robert Ginsburg, *supra* note 18.

²¹ *Id.*

For example, chemicals from a Caribbean reef sponge are used in producing AZT, a treatment for people with HIV infections.²²

Reefs also provide a major source of income around the world in the form of tourism. Ten million tourists visited the Great Barrier Reef in Australia in 1997 alone, producing over \$700 million in tourism revenue.²³ Florida had \$1.6 billion in revenue annually in the early 1990s from reef tourism.²⁴ Tourism provides half the total gross national product for countries in the Caribbean, whose beaches and reefs are the major attractions.²⁵ If the reefs fail completely, an important food and medicine source and the bulwark of island economies would be devastated.

Of course, there is a danger in reducing the importance of reefs or any ecosystem to their known value to humans. In his work, the eminent conservationist Aldo Leopold maintained that:

The last word in ignorance is the man who says of an animal or plant: "What good is it?" If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering.²⁶

Leopold argued for a "land ethic" that included the waters.²⁷ Leopold's conservation ethic is particularly relevant to the oceans, about which human understanding is still in its infancy compared to our understanding of the areas above the water line. In general, Leopold's ethic "changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it. It implies respect for his fellow-members, and also respect for the community as such."²⁸ Whether one believes in Leopold's ethic or merely in the economic value of coral reefs, the importance of these natural resources makes reefs worthy of conservation.

²² Alex Kirby, *Coral Reefs Much Rarer Than Thought*, BBC NEWS, Sept. 11, 2001, at http://news.bbc.co.uk/1/hi/english/sci/tech/newsid_1535000/1535383.stm (on file with the Harvard Environmental Law Review).

²³ SPAULDING ET AL., *supra* note 6, at 55.

²⁴ BIRKELAND, *supra* note 2, at 4.

²⁵ BRYANT ET AL., *supra* note 19, at 10.

²⁶ ALDO LEOPOLD, *ROUND RIVER* 146–47 (1993).

²⁷ See ALDO LEOPOLD, *A SAND COUNTY ALMANAC* 204 (1948) (writing that "[t]he land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land.").

²⁸ *Id.*

C. Reefs in Danger

The degradation of reefs has occurred so rapidly in some areas that scientists have barely been able to document their existence before they have disappeared.²⁹ Here in the United States, for example, close observers have witnessed major declines in their own lifetimes of the Florida reef, the only living barrier reef in the continental United States and the third longest in the world, following reefs in Australia and Belize.³⁰

Environmentalist Craig Quirolo, who created the nonprofit organization Reef Relief to document changes in the Florida reef, describes the gravity of the situation:

We never imagined in our wildest dreams that we would be watching hundred-year-old coral heads disappear in front of us in a matter of years. This one disease that we were able to document in time, the White Plague Type II, consumed nine centimeters around the corals . . . in a matter of 48 days Our reef is dying before our very eyes.³¹

Quirolo's statements are borne out in scientific assessments of the health of coral reefs. For example, in 1998 alone, one percent of the entire reef system in the Atlantic/Caribbean area was destroyed.³² Twenty-two percent of the Caribbean reef is already dead, and another twenty-two percent is expected to die in the next ten to thirty years.³³ In some areas, the devastation is nearly complete. Only five percent of Jamaica's once-glorious reef remains.³⁴ "What was a beautiful coral reef is now like a cemetery, covered with algae, fleshy algae," says Robert Ginsburg, a marine scientist.³⁵

The Atlantic/Caribbean reefs are not the only ones in decline. Ninety percent of the corals in certain areas of the Indian Ocean—representing five percent of the world's reef area—died during El Niño in 1998 due to a slight increase in the water temperature.³⁶ The United Nations Environment Programme's World Conservation Monitoring Center ("UNEP-WCMC") estimates that fifty-eight percent of all reefs are currently

²⁹ SPALDING ET AL., *supra* note 6, at 11.

³⁰ Florida Keys National Marine Sanctuary, *Visitor Information*, at http://www.fknms.nos.noaa.gov/visitor_information/welcome.html (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

³¹ Interview with Craig Quirolo, Director, Reef Relief, in Key West, Fla. (Jan. 27, 1998) (notes on file with the Harvard Environmental Law Review).

³² STATUS OF CORAL REEFS OF THE WORLD: 2000, REPORT OF THE GLOBAL CORAL REEF MONITORING NETWORK 30 (Clive Wilkinson ed., 2000) [hereinafter Wilkinson].

³³ *Id.*

³⁴ Interview with Robert Ginsburg, *supra* note 18.

³⁵ *Id.*

³⁶ UNEP-WCMC, *supra* note 8.

threatened by human activity, with reefs “degrading faster than data can be collected.”³⁷ The latest report from the Global Coral Reef Monitoring Network estimates that by 2010, forty percent of the world’s coral reefs may be lost and another twenty percent may perish by the year 2030.³⁸ This means that sixty percent of the world’s coral reefs are threatened with destruction over the next thirty years. Some experts are even more pessimistic and believe that coral reefs, in their present form, may not survive past 2020.³⁹ These observations and predictions demonstrate that the present and likely future state of coral reefs demand our immediate attention and action.

D. Human Stresses to the Reefs

The majority of coral reef destruction is a result of human action. The causes of coral reef degradation attributable to human activity fall into four major categories: overfishing; pollution; sedimentation; and climate change.⁴⁰

The United Nations Food and Agriculture Organization (“FAO”) has been tracking the supply of fish in the ocean and has found that the stocks of over seventy percent of the 200 major fish species are either fully or over-exploited if not actually being depleted.⁴¹ Fully exploited stocks have reached, or are very close to, their maximum catch limits; over-exploited stocks have no potential for increasing their catches.⁴² With the collapse of many high-value species such as salmon, bluefin tuna, and Nassau groupers, fishermen have to fish lower on the food chain for once-spurned species such as pollock and horse mackerel.⁴³ An historical comparison of fish catch data from Puerto Rico provides one example of the urgency of the situation. In 1931, fishermen caught three million pounds of fish; in 1990, they caught 2.3 million pounds.⁴⁴ Moreover, in 1931 only 711 fishing boats—only nine of which even had motors—caught these fish, while today there are 1197 boats.⁴⁵ Not only are humans directly affected by the depletion of fish stocks, but corals also have a complex relationship with the fish that inhabit them. For instance,

³⁷ Kirby, *supra* note 22.

³⁸ Wilkinson, *supra* note 32.

³⁹ See, e.g., Posting of Michael J. Risk, Professor, School of Geology and Geography, McMaster University, riskmj@mcmaster.ca, to coral-list-daily@coral.aoml.noaa.gov (Sept. 8, 2001) (on file with the Harvard Environmental Law Review).

⁴⁰ SPALDING ET AL., *supra* note 6, at 56.

⁴¹ FAO, *World Review of Fisheries and Aquaculture 2000*, pt. 1, at <http://www.fao.org/docrep/003/x8002e/x8002e04.htm> (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

⁴² *Id.*

⁴³ COLIN WOODARD, *OCEAN’S END* 42 (2000).

⁴⁴ Interview with James Bohnsack, Biologist, National Marine Fisheries Service, in Miami, Fla. (Jan. 23, 1998) (notes on file with the Harvard Environmental Law Review).

⁴⁵ *Id.*

the reefs provide food and habitat for the fish, while the herbivorous fish keep in check the distribution and abundance of reef algae, which could otherwise dominate and overwhelm the reef-building corals.⁴⁶ Half of all U.S. federally managed fisheries depend on coral reefs for at least part of their life cycle.⁴⁷ From a fisheries standpoint alone, it is in our best interest to preserve coral reefs.

As population pressures force more and more fishermen to chase fewer and fewer fish, their techniques become more extreme. Factory-type fishing trawlers that scrape the sea floor clean are one of the biggest destroyers of both fish stocks and life on the ocean floor.⁴⁸ In the Philippines, Micronesia, and Jamaica, to name just a few countries, fishermen use dynamite to blast the reefs, which stuns and kills all marine life in the area.⁴⁹ They reap a one-time bonanza from what floats to the surface, but leave nothing to replenish the stocks.⁵⁰ Another common practice used to supply live reef fish to restaurants and the aquarium market involves squirting cyanide to stun tropical fish.⁵¹ In the process, the fisherman kill much of the surrounding coral.⁵² Despite laws that make cyanide fishing illegal, more than one million kilograms of cyanide have been used on reefs in the Philippines since the 1960s, and the practice of cyanide fishing is spreading to regions as far away as Africa.⁵³

Human activity, such as development, overfishing, or irresponsible tourism, is the common denominator of the many threats to the health and existence of coral reefs. One study found that ten percent of reefs are already lost due to human impacts such as sedimentation and nutrient pollution from the land, mining of the reefs for sand and rock, and development on the reefs, particularly for airports.⁵⁴ Other reefs are assaulted with sewage disposal and sedimentation caused by runoff from deforestation.⁵⁵ Even agricultural fertilizer and herbicides applied to fields far from the reefs are creating total "dead zones" in the oceans and harming life on the reefs, which require clean, nutrient-free waters to thrive.⁵⁶

⁴⁶ BIRKELAND, *supra* note 2, at 231.

⁴⁷ National Oceanic and Atmospheric Administration ("NOAA"), *What Are Coral Reefs—And Why Are They In Peril?*, at <http://www.noaanews.noaa.gov/magazine/stories/mag7.htm> (Dec. 3, 2001) (on file with the Harvard Environmental Law Review).

⁴⁸ WOODARD, *supra* note 43, at 90.

⁴⁹ *Id.* at 45; see also SPAULDING ET AL., *supra* note 6, at 48 (describing the technique of blast fishing).

⁵⁰ WOODARD, *supra* note 43, at 45.

⁵¹ *Id.* at 46.

⁵² *Id.* at 45–46.

⁵³ BRYANT ET AL., *supra* note 19, at 15.

⁵⁴ STATUS OF THE CORAL REEFS OF THE WORLD: 1998, REPORT OF THE GLOBAL CORAL REEF MONITORING NETWORK, Exec. Summary (Clive Wilkinson ed., 1998).

⁵⁵ *Id.*

⁵⁶ See WOODARD, *supra* note 43, at 104–06; see also Reef Relief, *What is the Biggest Threat to the Health of Florida's Coral Reef?*, at http://www.reefrelief.org/coral_reef_florida.html (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

Furthermore, scientists are reporting more incidences of coral disease, particularly in the Caribbean.⁵⁷ Altogether, “[d]iseases have been observed on 106 species of coral (including some soft corals) on reefs in 54 countries around the world.”⁵⁸ The Caribbean has been particularly hard hit by diseases such as aspergillosis, white plague type II, black band disease, and white band disease.⁵⁹ The latter two diseases can destroy several millimeters of coral tissue in a single day.⁶⁰ In less than a decade, white band disease wiped out the primary reef-building coral in Belize, the staghorn coral, which had previously provided seventy percent of the coral cover in that area.⁶¹ Scientists do not know for certain why disease is taking such a toll on corals. Two diseases have been linked to pathogens—aspergillosis and white plague type II.⁶² There is some speculation that widespread die-offs, like that of the long-spined sea urchin in the Caribbean, are caused by a bacterial infection, possibly from natural causes or from diseases carried into the region by ballast water from ships.⁶³ While scientists have not yet determined if the increase in coral disease is due to human behavior, they have observed that over ninety-seven percent of coral diseases documented have occurred on reefs under medium to high threat from environmentally damaging human activities.⁶⁴ This correlation provides evidence of human causation.

Some scientists believe that climate change and ozone depletion currently pose the greatest threats to corals.⁶⁵ During the nine months of 1998 in which scientists recorded the largest ever El Niño and La Niña climate changes, approximately sixteen percent of the world’s reefs were destroyed by a phenomenon called “coral bleaching.”⁶⁶ Just a slight increase in water temperatures of one to two degrees Celsius can drive off the zooxanthellae, unicellular algae that live within corals. This causes the corals to lose their color, and, more important, can cause the entire colony to stop growing and reproducing.⁶⁷ If water temperatures increase four degrees Celsius or more for even just a few days, then ninety to ninety-five percent of coral colonies will die.⁶⁸

Currently, mass coral bleaching appears to be the result of periodic El Niño events, from which some reefs may recover. Recovery, however, will become increasingly difficult if, as climate models predict, sea tem-

⁵⁷ See SPALDING ET AL., *supra* note 6, at 62.

⁵⁸ *Id.*

⁵⁹ *Id.*

⁶⁰ *Id.*

⁶¹ OSHA GRAY DAVIDSON, FIRE IN THE TURTLE HOUSE 167 (2001).

⁶² SPALDING ET AL., *supra* note 6, at 62.

⁶³ *Id.* at 93.

⁶⁴ *Id.* at 63.

⁶⁵ WOODARD, *supra* note 43, at 46.

⁶⁶ Wilkinson, *supra* note 32, at 18.

⁶⁷ See GLOBAL MARINE BIOLOGICAL DIVERSITY 141 (Elliott A. Norse ed., 1993) [hereinafter Norse].

⁶⁸ *Id.*

peratures increase continually over the next thirty to fifty years.⁶⁹ Early signs indicate that we may experience another El Niño event in 2002,⁷⁰ with scientists recently reporting the early stages of bleaching in parts of the Great Barrier Reef.⁷¹

The increase in greenhouse gases resulting from human activity is likely to raise the Earth's average temperature from one to three degrees Celsius during the next century, introducing "new stresses to coastal and marine ecosystems, which are already under multiple stresses."⁷² Klaus Toepfer, Executive Director of UNEP, says that "[e]ach of these pressures [increased ocean temperatures, overfishing, poisons, sedimentation, sewage, and fertilizer run-off] is bad enough in itself, but together, the cocktail is proving lethal [to coral reefs]."⁷³ Just as human activity is the main cause of reef degradation, human activity is required to ensure the future survival of coral reefs.

III. BALANCING DEVELOPMENT NEEDS WITH REEF CONSERVATION

One of the challenges in any reef preservation program is balancing human needs against the value of reef preservation. It is somewhat ironic that coral reefs, among the richest ecosystems on the planet in terms of biodiversity, tend to exist in areas with high human population concentrations and in the economically poorest regions of the world.⁷⁴ "Without a doubt, the greatest risk factor for marine ecosystems is having high concentrations of humans as neighbors."⁷⁵ From the wealthiest to the poorest nations, humans have altered the marine environment through industrial development, harbor infrastructure, dumping toxic materials and nutrients, and overfishing.⁷⁶ Florida, for example, has some of the most degraded reefs in the Caribbean region. The reefs' demise began with the construction of a railway causeway out to the Keys over a hundred years ago.⁷⁷

Indonesia is a prime example of the conflict between development and reef survival. Indonesia lies in the center of a triangle of the greatest land and marine biodiversity on the planet.⁷⁸ Coral reefs situated in this

⁶⁹ SPALDING ET AL., *supra* note 6, at 61.

⁷⁰ See NOAA, *Is El Niño Coming Back?*, at <http://www.noaanews.noaa.gov/stories/s849.htm> (Jan. 10, 2002) (on file with the Harvard Environmental Law Review).

⁷¹ See Great Barrier Reef Marine Park Authority, *Coral Bleaching on the Great Barrier Reef*, at http://www.gbrmpa.gov.au/corp_site/bleaching/index.html (last modified Apr. 16, 2002) (on file with the Harvard Environmental Law Review).

⁷² Norse, *supra* note 67, at 140–41.

⁷³ UNEP-WCMC, *supra* note 8.

⁷⁴ See SPALDING ET AL., *supra* note 6, at 18 (containing a map depicting worldwide coral reef distribution).

⁷⁵ Norse, *supra* note 67, at 85.

⁷⁶ *Id.*

⁷⁷ SPALDING ET AL., *supra* note 6, at 97.

⁷⁸ DAVIDSON, *supra* note 61, at 52–53.

triangle boast seventy known genera of corals, compared to twenty in the Caribbean.⁷⁹ The human population is just as abundant. More than ten million people are crowded into Indonesia's capital city, Jakarta, where a "massive exodus from rural areas has swelled [Java's] urban population over the past few decades."⁸⁰ The stresses placed on the reefs near Jakarta by such a large population include carbon monoxide exhaust, large concentrations of lead particles in the atmosphere, outright mining of the corals to supply the intense building boom on the island, and worst of all, the introduction of untreated sewage directly into Jakarta Bay that would fill "seventy-five Olympic-sized swimming pools . . . each day."⁸¹

Scientists have documented the decline in the reef near Jakarta. In Jakarta Bay alone (roughly the size of Lake Tahoe), a scientist in 1939 counted ninety-six species of hard coral, whereas the Caribbean hosts about fifty species.⁸² In 1993, scientists counted a mere sixteen coral species, and one biologist noted in that year that "today none of the coral reefs in Jakarta Bay can be considered as functional coral reef communities . . . [They are] functionally dead."⁸³

There have not been great economic incentives for developing countries like Indonesia to protect their reefs. Long-term gains often pale in the face of immediate needs. As one scientist has noted, "[u]ntil the late 1980s, benefits from protecting biological diversity have tended to accrue to industrialized nations, while developing countries have paid the cost, by forsaking the economic benefits of activities that reduce biodiversity."⁸⁴ The United Nations has been experimenting with different programs to protect reefs while also addressing human needs in its sustainable development programs.

In Belize, for example, the United Nations Development Programme has developed a Coastal Zone Management program incorporating an ecosystem approach to coordinate policy between authorities that regulate land-based activities, such as forestry and agriculture, with water management authorities and fisheries representatives.⁸⁵ It is too early to tell if these programs will have a significant impact on coral reefs, given the dire predictions of their overall survival. But we know how critical reefs are to humans, and we also know that if we do nothing to change our effect on the reefs, many more will disappear in our lifetime.

⁷⁹ *Id.* at 53.

⁸⁰ *Id.* at 121.

⁸¹ *Id.* at 124.

⁸² *Id.* at 120.

⁸³ PROCEEDINGS OF THE COLLOQUIUM ON GLOBAL ASPECTS OF CORAL REEFS: HEALTH, HAZARDS AND HISTORY 308-09 (Robert N. Ginsburg ed., 1994).

⁸⁴ Norse, *supra* note 67, at 218.

⁸⁵ WOODARD, *supra* note 43, at 143.

IV. FEDERAL CORAL REEF INITIATIVES IN THE UNITED STATES

Until fairly recently, many in the modern world believed that our oceans could provide limitless resources and were impervious to human activity.⁸⁶ Only in the second half of the twentieth century did the United States begin to pay significant attention to the consequences of human activity on ocean life. First, Congress enacted a series of laws that indirectly benefited coral reefs, including the Fish and Wildlife Coordination Act of 1934,⁸⁷ the Fish and Wildlife Act of 1956,⁸⁸ the National Environmental Policy Act of 1969,⁸⁹ and the Magnuson Fishery Conservation and Management Act of 1976.⁹⁰ Given the interconnected nature of all life in the ocean, these initial efforts at marine preservation provided some rudimentary protection for coral reefs, but none was specifically directed at coral reefs.

Marine sanctuary designations were among the first attempts of the United States to use an ecosystem approach to protecting our ocean resources. They provide important recognition to a limited number of ocean habitats that are under assault. Moreover, they coordinate the work of federal agencies with overlapping jurisdiction in the sanctuary areas,⁹¹ providing more integrated protection. Although the designation of marine sanctuaries is a positive step in recognizing the negative human impact on the oceans, it alone is insufficient to ensure the preservation of the marine environment.

A. *The National Marine Sanctuaries Act*

Beginning in the 1970s with the devastation caused by massive oil spills in the oceans, Congress responded with new initiatives to protect

⁸⁶ See, e.g., *id.* at 34. But see BIRKELAND, *supra* note 2, at 383 (“Traditional fishing rights are quite at odds with Western legal concepts of the freedom of the seas, which are based on a naïve belief in the inexhaustibility of sea fisheries. Many systems of customary marine tenure eroded as a consequence of the actions of Western colonial governments, and some have been completely destroyed.”).

⁸⁷ Act of Mar. 10, 1934, ch. 55, Pub. L. No. 85-624, 48 Stat. 401 (codified as amended at 16 U.S.C. §§ 661–667d (2000)) (recognizing the importance of wildlife resources and authorizing the Secretary of the Interior to provide assistance to and cooperate with federal, state, and other authorities to protect wildlife).

⁸⁸ Act of Aug. 8, 1956, ch. 1036, § 2, Pub. L. No. 84-1024, 70 Stat. 1119 (codified as amended at 16 U.S.C. §§ 742a-j (2000)) (establishing, among other things, the position of Assistant Secretary of the Interior for Fish and Wildlife, and a Fisheries Loan Fund).

⁸⁹ Pub. L. No. 91-190, 83 Stat. 852 (1970) (codified as amended at 42 U.S.C. §§ 4321–4370 (1994 & Supp. V 1999) (declaring a national policy “to encourage productive and enjoyable harmony between man and his environment,” and requiring an environmental impact statement for proposed legislation and other major federal actions significantly affecting the environment).

⁹⁰ Pub. L. No. 94-265, 90 Stat. 331 (codified as amended in scattered sections of 16 U.S.C. (2000)) (recognizing the importance of fisheries to the U.S. economy and the dangers of overfishing).

⁹¹ See BIRKELAND, *supra* note 2, at 297.

the marine environment. The most important was Title III of the Marine Protection, Research, and Sanctuaries Act ("MPRSA") of 1972.⁹² The law created protected preserves that were in some ways similar to the land-based national parks system created nearly a century earlier.⁹³ The MPRSA allowed the Secretary of Commerce, who oversees the National Oceanic and Atmospheric Administration ("NOAA"), to designate marine sanctuary areas based on a variety of factors.

The original MPRSA established a system of Marine Protected Areas ("MPAs"),⁹⁴ and was designed to prevent the "unregulated dumping of material into ocean waters" that endangers "human health, welfare, or amenities, or the marine environment, ecological systems or economic potentialities."⁹⁵ Title III of the MPRSA charged the Secretary of Commerce to identify, designate, and manage marine sites based on their "conservation, recreational, ecological, or esthetic values" within the U.S. ocean territories and the Great Lakes.⁹⁶ After designating a marine sanctuary, the MPRSA authorized the Secretary to "issue necessary and reasonable regulations to control any activities permitted within the designated marine sanctuary."⁹⁷ This was the first effort to preserve marine ecosystems as a whole, and the primary concern was the deleterious effect of actively dumping waste into the ocean.

In its reauthorization of Title III of MPRSA in 1984, Congress greatly expanded the purpose and process of designating such protected areas.⁹⁸ The amended MPRSA provides for a balancing-of-needs inquiry before a sanctuary is added to the program. Congress instructed the Secretary of Commerce to look at areas of special national significance due to their "resource or human-use values" and to consider factors such as biological productivity, ecosystem structure, and threatened species present in the area.⁹⁹ The reauthorization also instructed the Secretary to consider an area's "historical, cultural, archaeological, or paleontological significance."¹⁰⁰

⁹² Pub. L. No. 92-532, tit. III, 86 Stat. 1052 (codified as amended at 33 U.S.C. §§ 1401-1421, 1441-1445, 2801-2805 (1994 & Supp. V 1999), and at 16 U.S.C. §§ 1431-1445, 1447 (2000)). During reauthorization of MPRSA in 1992, Title III was renamed the National Marine Sanctuaries Act ("NMSA"). The Oceans Act of 1992, 16 U.S.C. §§ 1431 (2000), and the National Marine Sanctuaries Preservation Act, 16 U.S.C. § 1445(b) (2000), amended the NMSA.

⁹³ NOAA, *Welcome to the National Program*, at <http://www.sanctuaries.nos.noaa.gov/natprogram/natprogram.html> (last modified Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

⁹⁴ See *infra* Part IV.C.

⁹⁵ 33 U.S.C. § 1401(a).

⁹⁶ 16 U.S.C. §§ 1433(a)(2)(A), 1432(3).

⁹⁷ MPRSA Amendments of 1980, Pub. L. No. 96-332, §2(2), 94 Stat. 1057 (codified as amended at 16 U.S.C. § 14325 (2000)).

⁹⁸ See MPRSA Amendments of 1984, Pub. L. No. 98-498, 98 Stat. 2296 (codified as amended at 16 U.S.C. § 1431(b) (2000)).

⁹⁹ *Id.* § 1433(a)-(b).

¹⁰⁰ *Id.* § 1433(b)(1)(B).

On the other side of the equation, the Secretary was to consider the negative impacts produced by "management restrictions on income-generating activities such as living and nonliving resources development; and the socioeconomic effects of sanctuary designation."¹⁰¹ Marine sanctuary status provides some protection, but does not eliminate all commercial activity within sanctuary boundaries. For this reason, some argue that marine sanctuaries are more similar to national forests, where commercial logging is permitted, than national parks.¹⁰²

The 1988 reauthorization of MPRSA enlarged the scope of the statute still further and allowed the sanctuaries program to collect and use funds obtained from resource damage claims.¹⁰³ Under the amended statute, "[a]ny vessel used to destroy, cause the loss of, or injure any sanctuary resource shall be liable *in rem* to the United States for response costs and damages resulting from such destruction, loss, or injury."¹⁰⁴ Thus, when vessels cause destruction through oil spills, groundings, or other actions that damage marine sanctuary resources, repairs can be made from recovered settlements. This is important because coral reefs tend to occur in shallow waters where they are more susceptible to human activity.

The National Marine Sanctuaries Act ("NMSA") does provide affirmative defenses for acts of God, war, third party acts, or negligible damage.¹⁰⁵ The courts, however, have interpreted these defenses very narrowly. For example, a federal district court in Florida granted summary judgment to the government in the case of the M/V *Miss Beholden*.¹⁰⁶ The court found that the ship intentionally ran aground the Western Sambo Reef in the Florida Keys National Marine Sanctuary during a storm in 1993, damaging or destroying 1025 square meters of live coral and 133 square meters of established reef framework.¹⁰⁷ The defendant shipowners were not allowed to use any of the affirmative defenses since bad weather had been forecast for the area two days before the accident. In 1996, the U.S. Court of Appeals for the Eleventh Circuit interpreted the NMSA as a strict liability statute and affirmed the lower court's damages award to the sanctuary when the ship *Jacquelyn L* ran aground on the same reef in the Florida Keys.¹⁰⁸

During the first twenty-five years of the program, thirteen marine sanctuaries have been established in the United States. The national ma-

¹⁰¹ *Id.* § 1433(b)(1)(H)-(I).

¹⁰² See, e.g., Sanjay Ranchod, *The Clinton National Monuments: Protecting Ecosystems with the Antiquities Act*, 25 HARV. ENVTL. L. REV. 535, 581 (2001).

¹⁰³ National Marine Sanctuaries Program Authorization Act of 1988, Pub. L. No. 100-627, 102 Stat. 3213 (codified as amended at 16 U.S.C. § 1443(a)(1) (2000)).

¹⁰⁴ *Id.* § 1443(a)(2).

¹⁰⁵ *Id.* § 1443(a)(3)(A)-(C).

¹⁰⁶ *United States v. M/V Miss Beholden*, 856 F.Supp. 668 (S.D. Fla. 1994).

¹⁰⁷ *Id.* at 669.

¹⁰⁸ *United States v. M/V Jacquelyn L*, 100 F.3d 1520 (11th Cir. 1996); see also 16 U.S.C. § 1443(a) (imposing strict liability for any injury to sanctuary resources).

rine sanctuaries system covers 18,000 square miles in the Atlantic and Pacific Oceans.¹⁰⁹ So far only five of the sanctuaries are home to coral reefs, including the Flower Garden Banks National Marine Sanctuary in the Gulf of Mexico and the Florida Keys National Marine Sanctuary.¹¹⁰ Flower Garden Banks, located 110 miles off the coasts of Texas and Louisiana, harbors the northernmost coral reefs in the United States and covers 41.7 square nautical miles, containing 350 acres of reef crest.¹¹¹

The Florida sanctuary runs alongside the Florida Keys and extends approximately 220 miles southwest from the southern tip of the Florida peninsula. The sanctuary is home to a complex ecosystem including seagrass meadows, mangrove islands, and living coral reefs of “extensive conservation, recreational, commercial, ecological, historical, research, educational, and aesthetic values.”¹¹² The Florida sanctuary may receive additional protection if the International Maritime Organization, a specialized agency of the United Nations, approves NOAA’s proposal to designate the area as a Particularly Sensitive Sea Area (“PSSA”).¹¹³ Since the waters around the Florida Keys are some of the most heavily trafficked shipping areas in the world, NOAA hopes that “PSSA status will help educate the international shipping community about the sensitivity of coral reef resources to international shipping activities and increase compliance with domestic measures already in place to protect the area.”¹¹⁴

There may soon be another U.S. reef included in the marine sanctuaries program. On December 4, 2000, President Clinton issued Executive Order 13,178 to establish the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve.¹¹⁵ The order recognizes that the United States holds three percent of the world’s coral reefs and that seventy percent of the U.S. total is located in Hawaii.¹¹⁶ The order establishes an eighty-four-million-acre reserve to protect Hawaii’s reefs.¹¹⁷ It would be the second-largest MPA on earth, exceeded only by the Great Barrier Reef in Australia.¹¹⁸

¹⁰⁹ See S. REP. NO. 106-353, at 2 (2000).

¹¹⁰ NOAA, *National Sanctuaries Programs: History*, at <http://www.sanctuaries.nos.noaa.gov/natprogram/nphistory/nphistory.html> (last modified Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

¹¹¹ NOAA, *NMS—Marine Sanctuaries—Flower Gardens* at <http://www.sanctuaries.nos.noaa.gov/oms/omsflower/omsflower.html> (last modified Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

¹¹² Florida Keys National Marine Sanctuary, *supra* note 30.

¹¹³ See Press Release, NOAA, NOAA Receives Initial Green Light to Extend International Protection to the Florida Keys (July 10, 2001), available at http://www.sanctuaries.nos.noaa.gov/news/pressreleases/pressreleases7_10_01.html (on file with the Harvard Environmental Law Review).

¹¹⁴ *Id.*

¹¹⁵ Exec. Order No. 13,178, 65 Fed. Reg. 76,903 (Dec. 4, 2000).

¹¹⁶ *Id.*

¹¹⁷ *Id.* 76,906–07.

¹¹⁸ See Tim Breen, *Coral Reefs: Enviro Concerned by White House Review of Hawaiian Reserve*, GREENWIRE, July 24, 2001, at LEXIS, News Library, Wire Service Stories File.

The final order establishing the Hawaiian reserve caps the current level of commercial and recreational fishing at the amount taken in 2000, except in specific areas of the reserve where fishing is prohibited.¹¹⁹ It prohibits all other commercial activity such as drilling, oil and mineral exploration, anchoring of boats, discharging any material into the water, or collecting items from the reserve.¹²⁰ President Clinton made the executive order using his authority under a variety of laws¹²¹ including the NMSA, the Endangered Species Act of 1973 ("ESA"),¹²² and the National Historic Preservation Act.¹²³ The executive order directs the Secretary of Commerce to initiate the process to designate the reserve as a national marine sanctuary under the National Marine Sanctuaries Program Authorization Act of 1988.¹²⁴

President Bush suspended the executive order establishing the Hawaiian reserve shortly after taking office,¹²⁵ but an interim Reserve Operations Plan was approved in March 2002.¹²⁶ NOAA opened the Reserve Operations Plan to public comment in March 2002 with a final plan expected by Summer 2002.¹²⁷ The plan will guide management of the reserve during the process of designating it a national marine sanctuary.¹²⁸

The national marine sanctuaries program is the best federal effort to date to protect coral reefs. The program would be more successful, though, if there were more coordination with local, state, and federal authorities to reduce the amount of land-based pollution entering the sanctuaries and degrading the reefs, particularly the near-shore reefs off the coast of Florida.

B. *The Antiquities Act*

President Clinton took another avenue of executive power to protect coral reefs using the Antiquities Act of 1906.¹²⁹ Shortly before leaving office, Clinton employed the Act to establish the Virgin Islands Coral

¹¹⁹ Exec. Order No. 13,178, 65 Fed. Reg. 76,903, 79,907; Exec. Order No. 13,196, 66 Fed. Reg. at 7395 (Jan. 18, 2001) (finalizing Exec. Order No. 13,178).

¹²⁰ Exec. Order No. 13,178, 65 Fed. Reg. at 76,907-08.

¹²¹ *Id.*

¹²² 16 U.S.C. § 1531 (2000).

¹²³ 16 U.S.C. § 470 (2000).

¹²⁴ Exec. Order No. 13,178, 65 Fed. Reg. At 76,905.

¹²⁵ See Susan Roth, *Bush Puts Coral Reef Reserve Plan on Hold*, GANNETT NEWS SERVICE, Jan. 24, 2001.

¹²⁶ Press Release, NOAA, NOAA Moves to Strengthen Protections for Northwestern Hawaiian Island (Mar. 15, 2002), available at <http://www.publicaffairs.noaa.gov/releases2002/mar02/noaa02r404.html> (on file with the Harvard Environmental Law Review).

¹²⁷ Notice of Availability of the Draft Reserve Operations Plan for the Northwestern Hawaiian Islands Ecosystem Reserve for Public Comment, 67 Fed. Reg. 11,997, 11,997 (Mar. 18, 2002).

¹²⁸ *Id.* at 11,998.

¹²⁹ 16 U.S.C. §§ 431-433 (2000).

Reef National Monument¹³⁰ and expand the Buck Island Reef National Monument in the U.S. Virgin Islands.¹³¹ Together, the two designations set aside 30,843 marine acres as monuments.¹³² The Virgin Islands monument protects a fragile Caribbean tropical ecosystem and recognizes the interdependence of the fishery habitats, the “mangroves, sea grass beds, coral reefs, octocoral hardbottom, sand communities, shallow mud and fine sediment habitat, and algal plains.”¹³³ The expanded Buck Island Reef National Monument now encompasses “additional coral reefs . . . barrier reefs, sea grass beds, and sand communities, as well as algal plains, shelf edge, and other supporting habitats not included within the initial boundary.”¹³⁴

Clinton’s use of the Antiquities Act represented a departure from the typical national monument designation.¹³⁵ Traditionally, national monuments were selected to preserve “curiosities . . . that stand out from the landscape by virtue of their extraordinary beauty, or unusual geographic or historical value”¹³⁶ Clinton’s novel use of the Antiquities Act created national monuments that “revolve around large ecosystems that are distinct and of significance.”¹³⁷ The Antiquities Act directs the president to limit the parcels or public lands set aside as monuments to “the smallest area compatible with the proper care and management of the objects to be protected.”¹³⁸ While Clinton’s expansion of the Antiquities Act from individual “curiosities” to entire ecosystems is novel, it corresponds with the growing knowledge that an individual species does not exist independent of its surroundings; rather, an ecosystem is a community in which all parts are interdependent.

Designation as a national monument under the Antiquities Act may provide greater and quicker protection for coral reefs than designation as a marine sanctuary currently provides. The Antiquities Act does not require the level of intragovernmental consultation, public participation, and congressional oversight that the NMSA requires.¹³⁹ Unlike the

¹³⁰ Proclamation No. 7399, 66 Fed. Reg. 7364 (Jan. 22, 2001).

¹³¹ Proclamation No. 7392, 66 Fed. Reg. 7335 (Jan. 22, 2001).

¹³² See *id.* at 7338 (reserving 18,135 marine acres for the Buck Island preserve); Proclamation No. 7399, 66 Fed. Reg. at 7367 (reserving 12,708 marine acres for the Virgin Islands preserve).

¹³³ Proclamation No. 7399, 66 Fed. Reg. at 7364.

¹³⁴ Proclamation No. 7392, 66 Fed. Reg. at 7335.

¹³⁵ See Ranchod, *supra* note 102, at 569.

¹³⁶ Judith Graham, *U.S. Land Protection Plans are Monumental*, CHI. TRIB., Feb. 18, 2000, at 3 (quoting Secretary of the Interior Bruce Babbitt).

¹³⁷ *Id.* It is important to note that previous presidents also used the Antiquities Act to protect public lands. Several were later redesignated as national parks by Congress, including the Grand Canyon, Zion, Bryce Canyon, and Joshua Tree. Ranchod, *supra* note 102, app. A, at 585–87.

¹³⁸ 16 U.S.C. § 431 (2000).

¹³⁹ See *id.*; see also NMSA, 16 U.S.C. § 1434(a)(3) & (6) (2000). But see National Monument Fairness Act of 2001, H.R. 2114, 107th Cong. (would amend the Antiquities Act to require the president to allow public participation in future monument designations).

NMSA, the Antiquities Act does not require the president to consider conflicting uses of the area.¹⁴⁰ However, due to the unilateral nature of the executive action under the Antiquities Act, the underwater monuments could be in greater danger than marine sanctuaries of being reversed or eviscerated by subsequent presidents or congressional action. This danger includes inadequate funding to carry out the intent of the designating executive order.¹⁴¹ Since the passage of the Antiquities Act, fourteen of seventeen presidents have used it to establish 123 national monuments.¹⁴² Congress has only abolished seven of those monuments and five others have been reduced in size,¹⁴³ which seems to indicate Congress's reluctance to override the Executive in this area.

C. Marine Protected Areas

MPAs refer to an existing patchwork of local, state, and national efforts to protect corals. These efforts preserve, to varying degrees, certain areas of the nation's waters, including some areas with coral reefs. In the United States, MPA is an umbrella term that includes "national marine sanctuaries, fisheries management zones, national seashores, national parks, national monuments, critical habitats, national wildlife refuges, national estuarine research reserves, state conservation areas, state reserves, and many others."¹⁴⁴

Recognizing that the seas have generally been treated as "commons" available to everyone, whether within a country's boundaries or on the high seas, MPAs have specific boundaries with "permitted and non-permitted uses within [them]."¹⁴⁵ An MPA may be established for a variety of reasons, such as maintaining fisheries through "no-take" zones, high species diversity, critical habitat for particular species, special cultural values (historic, religious, or recreational), or tourist attractions.¹⁴⁶ Some MPAs restrict or forbid human activity within the protected area, while others simply manage an area to enhance ocean use.¹⁴⁷

involving more than 50,000 acres).

¹⁴⁰ See 16 U.S.C. §§ 431–433.

¹⁴¹ See, e.g., Ranchod, *supra* note 102, at 552–55.

¹⁴² *Id.* at 544–46. Only Presidents Nixon, Reagan, and Bush have failed to use the Antiquities Act to protect public lands. *Id.* at 545.

¹⁴³ Veronica Larvie, Protection of Cultural Resources: the Antiquities Act and National Monuments, Paper Presented at American Law Inst.-American Bar Ass'n Federal Lands Law Conference (Oct. 18–19, 2001), LEXIS, Secondary Legal Library, Combined ALI-ABA Course of Study Materials File.

¹⁴⁴ NOAA, *What Is a Marine Protected Area*, at <http://mpa.gov/mpadescriptive/whatis.html> (last modified Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

¹⁴⁵ SALM & CLARK, *supra* note 2, at 13.

¹⁴⁶ *Id.* at 13–14.

¹⁴⁷ *Id.* at 14–15.

In May 2000, President Clinton signed Executive Order 13,158 to strengthen and expand the nation's system of MPAs.¹⁴⁸ The executive order places primary responsibility for developing a national system of MPAs in the hands of the Department of the Interior ("DOI") and the Department of Commerce ("DOC").¹⁴⁹ NOAA calls the creation of a comprehensive system of MPAs "perhaps the most important, and most challenging, ocean management effort of the 21st century,"¹⁵⁰ and one that "has never been attempted by our nation."¹⁵¹

The administering departments have developed two parallel tracks to carry out the executive order. The first is an evaluation of the existing MPAs, including recommendations for improving them, and recommendations for creating new MPAs. The other is a science-based track that will develop tools and management strategies to support a national MPA network.¹⁵²

One of the first tasks under the executive order is to "publish and maintain a list of MPAs"¹⁵³ existing in the United States. Because of the varied definitions of MPA, the executive order specifically defines MPA as "any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein."¹⁵⁴ The order further defines "marine environment" to mean "those areas of coastal and ocean waters, the Great Lakes and their connecting waters, and submerged lands thereunder, over which the United States exercises jurisdiction, consistent with international law."¹⁵⁵ After the departments compile the list of existing MPAs, new candidates for protection can be added.

One of the major challenges in designing a comprehensive national system of MPAs will be "[c]oordinating management efforts across areas of complex, multiple jurisdictions."¹⁵⁶ The executive order addresses this challenge by directing the implementing agencies to create the following: a Web site to facilitate information sharing;¹⁵⁷ an MPA Federal Advisory Committee to provide expert advice on and recommendations for the national system of MPAs;¹⁵⁸ and a National MPA Center, whose mission is

¹⁴⁸ Exec. Order No. 13,158, 65 Fed. Reg. 34,909 (May 26, 2000).

¹⁴⁹ See *id.* at 34,909–10.

¹⁵⁰ NOAA, *The Challenges*, at <http://mpa.gov/mpadescriptive/challenges.html> (last modified Apr. 28, 2002) [hereinafter *Challenges*] (on file with the Harvard Environmental Law Review).

¹⁵¹ NOAA, *The National MPA Initiative*, at <http://mpa.gov/mpadescriptive/natinitiative.html> (last modified Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

¹⁵² See *id.*

¹⁵³ Exec. Order No. 13,158, 65 Fed. Reg. at 34,910.

¹⁵⁴ *Id.* at 34,909.

¹⁵⁵ *Id.*

¹⁵⁶ *Challenges*, *supra* note 150.

¹⁵⁷ Exec. Order No. 13,158, 65 Fed. Reg. at 34,909.

¹⁵⁸ *Id.* at 34,910.

to develop a “framework for a national system of MPAs, and to provide Federal, State, territorial, tribal, and local governments with the information, technologies, and strategies to support the system.”¹⁵⁹ Funding the initiative will be a further challenge, especially because the executive order does not provide for funding.

President Bush has endorsed Executive Order 13,158 and requested \$3 million for the MPA initiative.¹⁶⁰ In response, Congress appropriated that funding in the 2003 fiscal year budget.¹⁶¹

The DOC has begun to carry out its mandate under Executive Order 13,158. The DOC has created a Web site,¹⁶² established the National MPA Center, and opened two training and technical assistance institutes in Fall 2000.¹⁶³ To date, the MPA initiative has catalogued 317 sites in the United States, primarily those under the federal jurisdiction of NOAA and DOI, and is working to gather information on more state and federal/state MPAs.¹⁶⁴

An important feature of the executive order is the requirement that federal agencies identify those actions that will “affect the natural or cultural resources that are protected by an MPA.”¹⁶⁵ The order states that in taking such actions, the agency “shall avoid harm to the natural and cultural resources that are protected by an MPA,” although the agency is only required to avoid such harm “[t]o the extent permitted by law and to the maximum extent practicable.”¹⁶⁶ The order further requires each federal agency affected by the order to prepare, and make public, a description of the actions taken by that agency in the previous year to implement the order.¹⁶⁷

The executive order itself does not create any right or benefit “enforceable in law or equity by a party against the United States, its agencies, its officers, or any person.”¹⁶⁸ However, DOI and DOC already possess some enforcement authority over MPAs.¹⁶⁹ DOI has jurisdiction over

¹⁵⁹ *Id.*

¹⁶⁰ NOAA, MARINE PROTECTED AREAS: STATUS OF NOAA ACTIVITIES UNDER EXECUTIVE ORDER 13158 (2001), available at http://mpa.gov/images/mpa_business/reports/mpa%20factsheet%20oct%202001.pdf [hereinafter MPA Report].

¹⁶¹ See NOAA, FY 2003 President's Budget, 34, 165 (2002), available at <http://www.ofo.noaa.gov/~nbo/Blue%20Book/NOAA%20Book.pdf>.

¹⁶² NOAA, *Marine Protected Areas of the United States*, at <http://mpa.gov> (last modified Apr. 28, 2002).

¹⁶³ See MPA Report, *supra* note 160.

¹⁶⁴ NOAA, *Marine Protected Areas of the United States: The MPA Inventory*, at http://mpa.gov/mpaservices/inv_status/status_inv.html (last modified Apr. 28, 2002) (on file with the Harvard Environmental Law Review). There are 251 federal sites, including national parks, national wildlife refuges, national marine sanctuaries, and fisheries management areas. *Id.*

¹⁶⁵ Exec. Order No. 13,158, 65 Fed. Reg. 34,909, 34,909 (May 26, 2000).

¹⁶⁶ *Id.*

¹⁶⁷ *Id.* at 34,911.

¹⁶⁸ *Id.*

¹⁶⁹ See Robin Kundis Craig, *The Coral Reef Task Force: Protecting the Environment*

“1.8 million of the nation’s 4.2 million acres of coral reefs”¹⁷⁰ with the authority to promulgate regulations for those designated as national parks, including fines and jail sentences for violations of the law.¹⁷¹ Also, as discussed earlier, the NMSA gives the Secretary of Commerce considerable enforcement authority.¹⁷²

Given that Congress has not yet enacted a comprehensive, coordinated, long-term national policy to protect the nation’s coral reefs,¹⁷³ the MPA executive order is an important new tool in managing ocean resources that could eventually prove beneficial to coral reefs. Its success will depend on Congress’s long-term willingness to fund the mandate, which Congress has shown an indication of doing.

The United States joins a number of other countries in experimenting with MPAs as a way of protecting important ecosystems. One of the best examples of an MPA is the Great Barrier Reef of Australia. It is cited as a “model of integrated and multiple-use management, allowing sustainable utilization of the reef by a wide range of users with numerous and often conflicting needs.”¹⁷⁴ Another promising example is the Bonaire Marine Park in the Caribbean, a self-funded park “supported entirely from tourist revenues (which also bring in half of that country’s total gross domestic product).”¹⁷⁵ In the Philippines, the Apo Island Reserve “has allowed [fish] stocks to recover sufficiently so that local fishermen operating in the surrounding areas are reporting major increases in fish yields.”¹⁷⁶ The United States could draw on the best practices from these successful MPAs to enhance its own fledgling system in protecting its marine resources.

D. U.S. Coral Reef Task Force

The increased awareness of the importance of coral reefs to the ocean system has spawned other federal efforts designed specifically to protect them. In 1998, the year of the mass coral bleaching event, President Clinton issued Executive Order 13,089, entitled “Coral Reef Protection.”¹⁷⁷ The order affirmatively requires all federal agencies to identify actions that may affect U.S. coral reefs and to ensure, subject to certain exceptions, that their actions will not degrade those ecosystems.¹⁷⁸

Through Executive Order, 30 Env’tl. L. Rep. (Env’tl. L. Inst.) 10,343, 10,357 (2000).

¹⁷⁰ *Id.* at 10,358.

¹⁷¹ *Id.* at 10,357.

¹⁷² See *supra* note 97 and accompanying text.

¹⁷³ Craig, *supra* note 169, at 10,343.

¹⁷⁴ BRYANT ET AL., *supra* note 19, at 44.

¹⁷⁵ *Id.*

¹⁷⁶ *Id.*

¹⁷⁷ Exec. Order No. 13,089, 63 Fed. Reg. 32,701 (June 16, 1998).

¹⁷⁸ *Id.* at 32,701.

Executive Order 13,089 also created the U.S. Coral Reef Task Force ("CRTF"). Chaired by the Secretaries of the Interior and Commerce, the CRTF has the following responsibilities: to coordinate efforts to map and monitor all U.S. coral reefs; to research the causes of, and solutions for, coral reef degradation; to reduce and mitigate coral reef degradation from pollution, over-fishing and other causes; and to implement strategies to promote conservation and sustainable use of coral reefs internationally.¹⁷⁹

In March 2000, the CRTF released a National Action Plan calling for twenty percent of all U.S. coral reefs to be designated as no-take ecological reserves by 2010.¹⁸⁰ A no-take zone is a particular type of MPA that bans all consumptive uses, including fishing and mineral extraction.¹⁸¹ The National Action Plan also calls for all U.S. coral reefs to be mapped by 2007, since only a small percentage of U.S. reefs have been adequately mapped.¹⁸² During one of its first meetings, the CRTF voted to take complaints from members of the public that believe a federal agency has violated the executive order.¹⁸³ The first complaint came in late 1999 from the government of Puerto Rico, which accused the U.S. Navy of destroying its coral reef during bombing exercises in Vieques.¹⁸⁴ President Bush said in June 2001 that "he believed that the training site should be phased out by May 2003."¹⁸⁵ The CRTF National Action Plan also states that the Department of Defense is actively working to implement Executive Order 13,089 "to the maximum extent feasible consistent with mission requirements."¹⁸⁶ Given the rapid demise of our nation's coral reefs, the government should implement the National Action Plan's proposals immediately.

As in the executive order concerning MPAs, funding will be crucial to the success of the CRTF's mission. In December 2001, DOC allocated \$34 million to the CRTF for coral reef conservation,¹⁸⁷ a good indication that the current administration has some commitment to preserving coral reefs.

The CRTF's National Action Plan was followed that same year by the Coral Reef Conservation Act of 2000.¹⁸⁸ The Act incorporated by ref-

¹⁷⁹ *Id.* at 32,702.

¹⁸⁰ CRTF, THE NATIONAL ACTION PLAN TO CONSERVE CORAL REEFS 20 (2000) [hereinafter NATIONAL ACTION PLAN].

¹⁸¹ James N. Sanchirico, Marine Protected Areas as Fishery Policy: A Discussion of Potential Costs and Benefits 2-3 (May 2000) (unpublished discussion paper, Resources for the Future) (on file with the Harvard Environmental Law Review).

¹⁸² *Id.* at 11.

¹⁸³ *1st Task Force Case: Vieques Coral Reef*, ORLANDO SENTINEL, Nov. 4, 1999, at A12.

¹⁸⁴ *Navy Accused of Blowing Up Reefs*, L.A. TIMES, Nov. 4, 1999, at A31. On the last day of 2001, a federal judge dismissed Puerto Rico's lawsuit to block further bombing on Vieques. *Puerto Rico v. Rumsfeld*, 180 F. Supp. 2d 145, 147 (D.D.C. 2001).

¹⁸⁵ *Puerto Rico Loses Lawsuit Over Vieques*, L.A. TIMES, Jan. 3, 2002, at A16.

¹⁸⁶ NATIONAL ACTION PLAN, *supra* note 180, at 24.

¹⁸⁷ See NOAA, *Commerce Department Announces \$34 Million Funding for Coral Reef Conservation*, at <http://www.noaanews.noaa.gov/stories/s835.htm> (Dec. 5, 2001) (on file with the Harvard Environmental Law Review).

¹⁸⁸ Pub. L. No. 106-652, tit. II, § 202, 114 Stat. 2800 (codified at 16 U.S.C. § 6401-6409).

erence the provisions of Executive Order 13,089.¹⁸⁹ It continues the CRTF and the U.S. Coral Reef Initiative, an existing partnership between governmental and commercial interests whose purpose is to design “management, education, monitoring, research and restoration efforts to conserve coral reef ecosystems”¹⁹⁰ A primary objective of the Coral Reef Conservation Act is to provide matching grants, subject to the availability of funds, to coral reef conservation projects.¹⁹¹ The Act authorizes a budget of \$8 million annually for a Coral Reef Conservation Fund through 2004.¹⁹²

Because the CRTF comprises representatives from eleven agencies, it represents a more coordinated effort than in the past and may provide much-needed leadership in responding to a growing environmental crisis both in the United States and internationally.

E. Endangered Species Act

The marine sanctuary approach to coral reef preservation attempts to conserve reefs as a whole. Regulations in the Florida Keys National Marine Sanctuary, for example, forbid removing, injuring, and even possessing any coral or live rock.¹⁹³ They also forbid collecting many species of fish, anchoring on live coral, and discharging waste anywhere in the sanctuary.¹⁹⁴ Another approach to conserving reefs is to protect specific coral species under the ESA.¹⁹⁵ While the ESA covers numerous marine creatures such as sea turtles and many species of reef and other fish, no corals have been added to the Federal Lists of Endangered and Threatened Wildlife and Plants (“ESA lists”).

In 1999 the National Marine Fisheries Service (“NMFS”) began to consider adding two species of coral found in the Caribbean to the ESA lists—elkhorn coral and staghorn coral.¹⁹⁶ According to NMFS, nearly ninety-six percent of these two species have disappeared during the last two decades due to hurricane damage, coral diseases, increased predation, boat groundings, sedimentation, and other factors.¹⁹⁷ While scien-

(2000)).

¹⁸⁹ *Id.*

¹⁹⁰ *Id.*

¹⁹¹ *Id.* §§ 6401, 6403.

¹⁹² *Id.* § 6408(c).

¹⁹³ Fla. Keys Nat’l Marine Sanctuary Regulations: Final Rule, 15 C.F.R. § 922 (2000).

¹⁹⁴ *Id.*

¹⁹⁵ 16 U.S.C. §§ 1531–1554 (2000).

¹⁹⁶ See Endangered and Threatened Species; Request for Information on Candidate Species List Under the Endangered Species Act, 64 Fed. Reg. 2629, 2629–30 (Jan. 15, 1999).

¹⁹⁷ NMFS, *Candidate Species: Staghorn Coral*, at http://www.nmfs.noaa.gov/prot_res/species/inverts/staghorncoral.html (last modified Jan. 4, 2001) (on file with the Harvard Environmental Law Review); NMFS, *Candidate Species: Elkhorn Coral*, at http://www.nmfs.noaa.gov/prot_res/species/inverts/elkhorncoral.html (last modified Jan. 4, 2001) (on file with the Harvard Environmental Law Review).

tists and activists debate whether a species-by-species approach can be effective when an entire ecosystem is under attack, many are supportive of any legal effort that enhances reef protection.

If these coral species were added to the ESA lists, they would receive protection throughout their habitat range, which includes areas currently outside the designated sanctuaries in the United States. The ESA forbids importing, taking, or even possessing species on the ESA lists.¹⁹⁸ Since corals are not easily visible to most of the public and do not have the charisma of large mammals, adding corals to the ESA could also serve as notice to the public that corals in general are disappearing.

The ESA's ban on the import of listed species into the United States is another important legal protection.¹⁹⁹ Reefs in the Philippines are being decimated by activities such as harvesting for export.²⁰⁰ Currently the United States is the main importer of stony corals from the Philippines as curios, even though legislation such as the MPRSA bans the collection on our own reefs.²⁰¹ More than half of the Philippines' exports of ornamental coral and exotic reef fish are sent to the United States.²⁰² If the ESA listed more coral species and banned their import, then fewer corals would likely be harvested in other countries because some of the U.S. market would dry up, at least among those who wish to comply with U.S. law.

Another argument for including species of coral on the ESA lists is that while naming discrete species, the ESA actually provides protection for the species' entire ecosystem. As the ESA states, "[t]he purposes of this [Act] are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved"²⁰³ The ESA forbids harming species included on the ESA lists.²⁰⁴ Federal regulations implementing the ESA define the word "[h]arm in the definition of 'take' [to mean] an act which actually kills or injures wildlife. Such acts may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering."²⁰⁵ The U.S. Supreme Court upheld this definition in *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*.²⁰⁶

¹⁹⁸ 16 U.S.C. § 1538(a)(1)(A)–(D).

¹⁹⁹ *Id.* § 1538(a)(1)(A).

²⁰⁰ See ROBIN BROAD & JOHN CAVANAGH, *PLUNDERING PARADISE: THE STRUGGLE FOR THE ENVIRONMENT IN THE PHILIPPINES* 38 (1993).

²⁰¹ See 16 U.S.C. §§ 1436–1437 (2000); see also Flower Garden Banks Nat'l Marine Sanctuary Regulations, 15 C.F.R. § 922.122 (2000).

²⁰² See BROAD & CAVANAGH, *supra* note 200, at 37–38.

²⁰³ 16 U.S.C. § 1531(b).

²⁰⁴ *Id.* §§ 1532(19), 1538(a)(1)(B)–(D).

²⁰⁵ Endangered and Threatened Wildlife and Plants, 50 C.F.R. § 17.3 (2000).

²⁰⁶ 515 U.S. 687 (1995). However, Justice Scalia, in a dissent joined by Chief Justice Rehnquist and Justice Thomas, argued that the destruction of habitat does not "harm" an endangered species within the meaning of the ESA. This dissent coincides with growing complaints that the ESA was mostly intended to preserve large animals, not tiny creatures

In later amendments to the ESA, Congress required that critical habitat be designated at the same time a species is listed.²⁰⁷ These provisions could provide enhanced protection for entire reefs where staghorn and elkhorn coral are located. Reefs are “extremely susceptible to sewage and industrial wastes, oil spills, siltation and water stagnation brought about by dredging and filling, thermal pollution and flooding with low salinity or silt laden water resulting from poor land management.”²⁰⁸ If the regulating agencies could prove the necessary nexus between these harms and destruction of the endangered corals’ habitat, then the ESA could become a powerful tool in combating reef degradation as it has been in rescuing individual species threatened with extinction.

F. Conclusion

The federal provisions described above have overlapping purposes, but leave many gaps in the protection of coral reefs. Table 1 summarizes the major domestic initiatives aimed at preserving marine resources, including coral reefs.

and their habitat. *Id.* at 714–25 (Scalia, J., dissenting). See generally Shannon Petersen, *Congress and Charismatic Megafauna: A Legislative History of the Endangered Species Act*, 29 ENVTL. L. 463 (1999) (discussing criticism of ESA’s protection of small, less well-known animals).

²⁰⁷ 16 U.S.C. § 1533(b)(6)(C).

²⁰⁸ A NEW LAW OF THE SEA FOR THE CARIBBEAN: AN EXAMINATION OF MARINE LAW AND POLICY ISSUES IN THE LESSER ANTILLES 126 (Edgar Gold ed., 1988).

TABLE 1. SUMMARY OF DOMESTIC PROVISIONS AFFECTING CORAL REEF CONSERVATION

Provision	Date	Scope of Provision	Terms of Provision	Effects on Coral Reefs
Marine Protection, Research, and Sanctuaries Act ("MPRSA")	1972	Selected marine areas	Regulates activities, mainly dumping, to protect ocean habitat. 1988 reauthorization allows damage claims.	Secondary benefits to reefs. Funds collected from reef destruction resulting from ship groundings.
Endangered Species Act	1973	Designated plant and animal species	Forbids taking or possessing of designated species.	No coral reef species listed, but reef habitat protected through designation of marine species that share the same habitat.
National Marine Sanctuaries Act (formerly Title III of the MPRSA)	1992	Selected marine areas	Secretary of Commerce to designate protected sites within ocean territories and regulate activities within sites.	Coral reefs located in five of the designated sanctuaries.
Executive Order 13,089	1998	All U.S. coral reefs	Requires all federal agencies to ensure that their actions do not degrade reef ecosystems. Creates the CRTF to research and implement strategies to map and protect coral reefs.	No enforceability against noncompliant agencies.
Executive Orders 13,178 & 15,196	2000	Marine reserve in northwestern Hawaiian Islands	Caps fishing at year 2000 levels and prohibits other commercial activities.	Reserve is a coral reef ecosystem.
Executive Order 13,158	2000	Marine Protected Areas ("MPAs")	Creates advisory committee to advise and coordinate strengthening and expansion of a comprehensive system of MPAs.	Benefits to coral reefs within MPAs.

Coral Reef Conservation Act of 2000	2000	All U.S. coral reefs	Incorporates Executive Order 13,089 and provides matching funds for reef conservation projects.	Same as Executive Order 13,089 and provides additional resources for reef conservation.
Antiquities Act of 1906	1906	Areas of extraordinary geographical, historical, aesthetic value	Authorizes president to designate sites of historic or scientific interest that are situated on federal public lands as national monuments. Each site to be limited to the smallest area compatible with the proper care and management of the objects to be protected.	Has been used by Presidential Proclamation in 2001 to create and expand two national monuments.
Proclamation 7399: Virgin Islands Coral Reef National Monument	2001	12,000 marine acres in the U.S. Virgin Islands		Monument includes coral reefs.
Proclamation 7392: The Buck Island Reef National Monument	2001	18,000 marine acres in the U.S. Virgin Islands		Monument includes coral reefs. Proclamation expands original monument thus protecting more coral reef.

The federal coral reef initiatives have been piecemeal until just recently. Executive Order 13,089 directly placed an affirmative duty on federal agencies not to harm coral reefs. Equally important was its directive to the CRTF to determine the extent of the United States' coral reef and map them. With that information in hand, and the necessary executive and congressional will, bodies such as the CRTF can devise and implement strategies to prevent further degradation of our coral reefs and make recommendations for more comprehensive legislation to preserve our reefs for the long term.

When they receive adequate funding to enforce them, the federal protections for coral reefs are useful. But, as stated earlier, we need greater control over human activities away from the reefs that contribute to reef degradation. This includes not only land-based sources of pollution and sedimentation, but also human behavior contributing to global climate change.²⁰⁹

²⁰⁹ "We are being forced to recognise that human reliance on burning fossil fuels and clearing rainforests is leading to changes in global climate, and that events like the extensive coral mortality in 1998 may occur more frequently and devastatingly in the future and not just to coral reefs." Wilkinson, *supra* note 32, at 7.

The federal efforts to protect coral reefs are not without criticism, both from those who would like to exploit the resources in the sanctuaries and from conservationists.²¹⁰ As one ardent supporter of the Florida reefs complains, "Generally, I think that local, peer-supported, community-based initiatives are honored whereas mandates from afar tend to be unenforceable and unenforced in most instances unless there is a heavy enforcement hand onsite."²¹¹ This critic believes that areas of the Florida Keys sanctuary were actually more protected prior to the sanctuary designation because the federal law does not provide adequate enforcement measures.²¹²

The United States has made great strides in recent decades in recognizing the importance of coral reefs and attempting to provide legal protections for some of them, but these protections obviously are not enough. Sanctuary status has not prevented the precipitous decline in the Florida reef system. Five hundred ship groundings a year occur in the Florida Keys National Marine Sanctuary.²¹³ Agricultural runoff from the mainland, and sewage dumping from 22,000 septic tanks, 5000 cesspools and 139 marinas all contribute to pollution and eutrophication in the sanctuary.²¹⁴ The sanctuary program needs to be coordinated with state and local efforts to eliminate these sources of pollution. Currently only one percent of the total sanctuary area in Florida is designated as no-take marine reserves.²¹⁵ Those areas show signs of recovery²¹⁶ and the no-take designations should be increased. These measures and a commitment to continue funding the efforts of the sanctuary programs, the CRTF and the MPA initiative, are essential to preserving the other U.S. coral reefs that have not yet borne the sustained assault that the Florida reef has.

The United States is slowly recognizing that coral reefs are precious resources that require legal protection. The Clinton administration made several attempts to address coral reefs directly. It remains up to future administrations to see that these laws are utilized for the maximum protection of reefs.

V. INTERNATIONAL PROTECTIONS FOR CORAL REEFS

A variety of international legal instruments either directly or indirectly provide protection for coral reefs. Though these measures offer

²¹⁰ See, e.g., *U.S. v. M/V Jacquelyn L.*, 100 F.3d 1520, 1521 (11th Cir. 1996) (discussing the controversial designation of the Florida Keys National Marine Sanctuary and opposition to it by Florida's governor).

²¹¹ E-mail from DeeVon Quirolo, Executive Director, Reef Relief, to author (Mar. 21, 2001) (on file with the Harvard Environmental Law Review).

²¹² See *id.*

²¹³ SPALDING ET AL., *supra* note 6, at 97-98.

²¹⁴ *Id.*

²¹⁵ *Id.*

²¹⁶ *Id.*

promise for enhanced protection of reefs, the level of protection depends on the ratification and enforcement of these instruments.

The United Nations Convention on the Law of the Sea (“UNCLOS”) remains the guiding document for ocean issues, but many other specialized conventions potentially afford greater protections for coral reefs. While this Note addresses current legal regimes for protecting reefs, it should be noted that traditional systems of control like customary tenure, where particular communities have ownership of reefs and their resources, frequently produced highly effective forms of reef management.²¹⁷

A. United Nations Convention on the Law of the Sea

UNCLOS²¹⁸ is the principal convention regarding the use of the ocean and its resources. UNCLOS grants every state “the right to establish the breadth of its territorial sea up to a limit not exceeding 12 nautical miles, measured from baselines determined in accordance with this Convention.”²¹⁹ The Convention states that “waters on the landward side of the baseline of the territorial sea form part of the internal waters of the State.”²²⁰ Moreover, Articles 56 and 57 of the Convention give coastal states sovereign rights in an “exclusive economic zone” out to 200 miles.²²¹ Because most reef formations are limited to waters of less than fifty meters depth,²²² they tend to occur in shore waters. This places the majority of coral reefs within some states’ internal waters and exclusive jurisdiction.

Reefs are specifically mentioned in Article 6 of UNCLOS, which states that “in the case of islands situated on atolls or of islands having fringing reefs, the baseline for measuring the breadth of the territorial sea is the seaward low-water line of the reef”²²³ Thus it might appear that UNCLOS does not provide much protection for coral reefs because they are within a state’s internal waters. However, UNCLOS was a landmark treaty in the development of international environmental law because it contains many conservation-oriented provisions.²²⁴ Specifically, it requires states to protect and maintain their marine species, even within internal waters.²²⁵

The preamble to UNCLOS states that among the primary objectives of the 1982 convention is the “study, protection and preservation of the

²¹⁷ *Id.* at 66.

²¹⁸ UNCLOS, Dec. 10, 1982, 1833 U.N.T.S. 397 (entered into force Nov. 16, 1994).

²¹⁹ *Id.* art. 3, at 400.

²²⁰ *Id.* art. 8, at 401.

²²¹ *See id.* arts. 56–57, at 418–19.

²²² A NEW LAW OF THE SEA FOR THE CARIBBEAN, *supra* note 208, at 126.

²²³ UNCLOS, *supra* note 218, art. 6, at 401.

²²⁴ *See* Jonathan L. Hafetz, *Fostering Protection of the Marine Environment and Economic Development: Article 121(3) of the Third Law of the Sea Convention*, 15 AM. U. INT’L L. REV. 583, 596 (1999).

²²⁵ *See* UNCLOS, *supra* note 218, arts. 192–94, at 477–78.

marine environment.”²²⁶ UNCLOS provides “the first comprehensive statement of international law on the issue . . . a movement toward regulation based upon a more holistic conception of the ocean as a resource that is exhaustible and finite, and ocean usage as a resource management question.”²²⁷ Even within the exclusive economic zones of coastal states, UNCLOS states that “the coastal State . . . shall ensure through proper conservation and management measures that the maintenance of the living resources in the exclusive economic zone is not endangered by over-exploitation.”²²⁸

UNCLOS contains many positive obligations that affect marine resources in national waters, such as coral. Part XII of the convention sets forth many of the international legal requirements pertaining to the marine environment, including a system for enforcing those requirements.²²⁹ Article 192 sets forth the general obligation “to protect and preserve the marine environment.”²³⁰ Article 193 recognizes the “sovereign right [of States] to exploit their natural resources” but this is subject to the “duty to protect and preserve the marine environment.”²³¹ Some of the specific requirements include taking measures necessary to “prevent, reduce and control pollution of the marine environment,”²³² and to ensure that activities “are so conducted as not to cause damage by pollution to other States and their environments”²³³ States must consider all sources of pollution to the marine environment, including the following: harmful or noxious substances from land-based sources, the atmosphere, or dumping; pollution from vessels; and contamination from other installations used to explore the seabed and subsoil.²³⁴

The duties expressed in Articles 192 to 194 are binding on states-parties to the Convention. Since 157 states have signed UNCLOS and 138 have ratified it,²³⁵ many commentators believe that the provisions are also statements of customary international law, which would make them binding on all nations that are not parties to the convention.²³⁶ Therefore,

²²⁶ *Id.* pmbl., at 397.

²²⁷ Moira L. McConnell & Edgar Gold, *The Modern Law of the Sea: Framework for the Protection and Preservation of the Marine Environment?*, 23 CASE W. RES. J. INT'L L. 83, 84–85 (1991) (noting that one nation's abuse of resources negatively affects other nations).

²²⁸ UNCLOS, *supra* note 218, art. 61, at 420.

²²⁹ *See id.* arts. 213–22, at 485–90.

²³⁰ *Id.* art. 192, at 477.

²³¹ *Id.* art. 193, at 478.

²³² *Id.* art. 194, at 478.

²³³ UNCLOS, *supra* note 218, art. 194, at 478.

²³⁴ *Id.*, art. 194, para. 3, at 478.

²³⁵ United Nations, *Status of the United Nations Convention on the Law of the Sea*, available at http://www.un.org/Depts/los/reference_files/status2002.pdf (Feb. 6, 2002).

²³⁶ *See* Hafetz, *supra* note 224, at 597. “Many experts have agreed that UNCLOS is not only a treaty but a codification and articulation of the present state of the rules applicable to the oceans, and, as such is binding on both signatories and nonsignatories as customary international law.” Suzanne Iudicello & Margaret Lytle, *Marine Biodiversity and International Law: Instruments and Institutions That Can Be Used to Conserve Marine Biological*

even though some countries, including the United States, have not ratified UNCLOS, they may be bound by many of its principles.

Prior to the 1982 UNCLOS, there was little international regulation of the marine environment, particularly its conservation. UNCLOS's provisions for the protection and preservation of the marine environment reflected the growing awareness of what was happening to our oceans. Unfortunately, many nations did not ratify the Convention, in part because of its controversial deep seabed provisions. Therefore, a major issue today is whether the Convention reflects customary international law so that it is binding on all nations, not just those that are parties to the convention.

B. Agenda 21

Ten years after the drafting of UNCLOS, more than 178 governments adopted Agenda 21, the final document of the United Nations Conference on Environment and Development ("UNCED") held in Brazil in 1992.²³⁷ Agenda 21 reaffirmed many of the goals of UNCLOS but also recognized that "[d]espite national, subregional, regional and global efforts, current approaches to the management of marine and coastal resources have not always proved capable of achieving sustainable development, and coastal resources and the coastal environment are being rapidly degraded and eroded in many parts of the world."²³⁸ Chapter 17 of Agenda 21 gives the protection of coral reefs high priority and calls for an integrated, international approach for their protection and use.²³⁹

To implement Chapter 17 and other international conventions, the International Coral Reef Initiative ("ICRI") was created at the Small Island Developing States conference in 1994.²⁴⁰ Through ICRI, over eighty developing countries with coral reefs "sit in equal partnership with major donor countries and development banks, international environmental and development agencies, scientific associations, the private sector and NGOs to decide on the best strategies to conserve the world's coral reef resources."²⁴¹ ICRI has developed "action plans" for all regions of the world and is now working with national governments and organizations

Diversity, 8 TUL. ENVTL. L.J. 123, 132 (1994).

²³⁷ United Nations Sustainable Development, *Agenda 21*, at <http://www.un.org/esa/sustdev/agenda21.htm> (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

²³⁸ UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT, AGENDA 21, ch. 17.4, at 131 (Vol. II), U.N. Doc. A/CONF.151/26 (1992) [hereinafter AGENDA 21].

²³⁹ *Id.* ch. 17.85(a), at 152 (Vol. II).

²⁴⁰ ICRI, *About the International Coral Reef Initiative*, at http://www.environnement.gouv.fr/icri/Site_ICRI/Au%20sujet%20de%20l'ICRI/about.html (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

²⁴¹ *Id.*

to implement those plans.²⁴² Like the CRTF, ICRI is still relatively new, and whether either body succumbs to bureaucratic wrangling or becomes an important force in the fight to preserve coral reefs remains to be seen.

Chapter 15 of Agenda 21, titled "Conservation of Biological Diversity," calls for immediate action in protecting the diversity of plant and animal resources. Chapter 15 states:

Despite mounting efforts over the past 20 years, the loss of the world's biological diversity, mainly from habitat destruction, over-harvesting, pollution and the inappropriate introduction of foreign plants and animals, has continued. . . . Urgent and decisive action is needed to conserve and maintain genes, species and ecosystems, with a view to the sustainable management and use of biological resources.²⁴³

Chapter 15 is especially significant for coral reefs because of their high biodiversity.

Agenda 21 represents a major development in ocean stewardship. Where previous international agreements looked at protecting specific ocean resources such as marine mammals and fish, Agenda 21 recognized the need for overall sustainable ocean development.²⁴⁴

C. Convention on Biological Diversity

The UNCED also produced the Convention on Biological Diversity ("CBD").²⁴⁵ The preamble to the convention asserts that "the conservation of biological diversity is a common concern of humankind."²⁴⁶ As the primary international agreement on biodiversity issues, the CBD's three objectives are the "conservation of biological diversity, sustainable use of its components, and a fair and equitable sharing of the benefits of genetic resources."²⁴⁷

The CBD does not name specific ecosystems but provides for the identification and monitoring of two distinct categories: (1) ecosystems and habitats; and (2) species and communities.²⁴⁸ Among the factors to

²⁴² See ICRI, *ICRI Achievements 1995-1998*, at http://www.icriforum.org/router.cfm?show=secretariat/sec_home.html&Item=1 (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

²⁴³ AGENDA 21, *supra* note 238, ch. 15.3, at 103 (Vol II).

²⁴⁴ See Robin Kundis Craig, *Sustaining the Unknown Seas: Changes in U.S. Ocean Policy and Regulation Since Rio '92*, 32 *Envtl. L. Rep. (Envtl. L. Inst.)* 10,190, 10,191 (2002).

²⁴⁵ CBD, June 5, 1992, 1760 U.N.T.S. 143 (entered into force Dec. 29, 1993).

²⁴⁶ *Id.* at 143.

²⁴⁷ U.S. Dep't of State, *Biodiversity and the Convention on Biodiversity*, at http://www.state.gov/www/global/oes/fs-biodiversity_990105.html (Jan. 5, 1999) (on file with the Harvard Environmental Law Review).

²⁴⁸ CBD, *supra* note 245, annex I, at 165.

consider in identifying ecosystems and habitats for protection are those “containing high diversity, large numbers of endemic or threatened species, or wilderness; required by migratory species; of social, economic, cultural or scientific importance; or, which are representative, unique or associated with key evolutionary or other biological processes.”²⁴⁹ Species and communities covered by the CBD include those that are “threatened . . . ; of medicinal, agricultural or other economic value; or social, scientific or cultural importance; or importance for research into the conservation and sustainable use of biological diversity, such as indicator species.”²⁵⁰ The purpose behind these broad criteria is to ensure that the CBD encompasses all possible areas of biodiversity.

The specific terms of the convention obligate parties to comply with a variety of provisions in addition to identifying and monitoring the components of biological diversity. These provisions involve establishing protected areas, integrating conservation and sustainable use of biological resources into national decision-making, educating the public, and facilitating access of other states to genetic resources.²⁵¹ The CBD contains no enforcement mechanism, and, as the Convention’s Secretariat explains, “to a large extent, compliance will depend on informed self-interest and peer pressure from other countries and from public opinion.”²⁵² Countries that ratify the Convention must submit regular reports on what they have done to implement its provisions.²⁵³ This report goes to the Conference of the Parties—the governing body that oversees implementation of the CBD.²⁵⁴

As of March 2002, there were 183 parties to the Convention, and six countries that had signed, but not yet ratified it.²⁵⁵ Among the six is the United States. The Clinton administration urged the Senate to ratify the CBD, in part because:

biological diversity . . . represents the “raw material” for the world’s agricultural and pharmaceutical industries. Organisms yet to be discovered or studied could hold the key to a future cure for some terrible disease, or their genetic material may be

²⁴⁹ *Id.*

²⁵⁰ *Id.* annex I, para. 2, at 165.

²⁵¹ See *id.* art. 8, at 148–49, art. 10, at 150, art. 13, at 151, art. 15, at 152.

²⁵² Secretariat of the CBD, *International Action*, at <http://www.biodiv.org/doc/publications/guide.asp?id=action-int> (last modified Nov. 21, 2001) (on file with the Harvard Environmental Law Review).

²⁵³ CBD, *supra* note 245, art. 26, at 159.

²⁵⁴ *Id.* arts. 23 & 26, at 157–59.

²⁵⁵ See Secretariat of the CBD, *Parties to the Convention on Biological Diversity/Cartagena Protocol on Biosafety*, at <http://www.biodiv.org/world/parties.asp> (last modified Mar. 15, 2002) (on file with the Harvard Environmental Law Review).

useful in improving crop[s] . . . [and] help feed the world's expanding population²⁵⁶

The United States has been concerned about the CBD's impact on intellectual property rights, technology transfer, and finance provisions.²⁵⁷ While the Senate Foreign Relations Committee favorably reported the convention to the full Senate in 1994, the Senate curtailed further consideration of the treaty due to concerns about the CBD's effect on land use and agriculture in the United States.²⁵⁸

The CBD is a framework treaty and has been described as containing "primarily aspirational provisions, with matters of substance left to future development by its own Conference of the Parties."²⁵⁹ These objectives are connected through a principle known as "common but differentiated responsibility." This principle holds that "developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command."²⁶⁰ In other words, countries such as the United States that use a disproportionate share of the world's resources have a special responsibility to find a balance between resource use and preservation. As one commentator pointed out, the most biologically diverse areas left on the planet are mostly in poorer countries of the developing world, and they understandably feel "possessive of those resources."²⁶¹ Since the North has already consumed much of its own biodiversity, "the South would embrace sustainable development only if the North would assume the costs, and only through projects that would not compromise a growing sense of sovereignty over natural resources."²⁶² A balanced approach to conserving biodiversity must take account of how various levels of development affect a state's management of its natural resources.

The CBD was created at a critical point because "[m]any biologists believe we are in the midst of one of the great extinction spasms of geological history."²⁶³ This would be the seventh mass extinction event, the last one occurring 65 million years ago when the dinosaurs disap-

²⁵⁶ U.S. Dep't of State, *supra* note 247.

²⁵⁷ *Id.*

²⁵⁸ *Id.*; see also 140 CONG. REC. S13791 (daily ed. Sept. 30, 1994) (statement of Sen. Burns against the CBD because it "could give a panel outside the United States the right to dictate what our environmental laws should say.")

²⁵⁹ LAKSHMAN D. GURUSWAMY & BRENT R. HENDRICKS, INTERNATIONAL ENVIRONMENTAL LAW IN A NUTSHELL 91 (1997).

²⁶⁰ Rio Declaration on Environment and Development, Principle 7, June 14, 1992, 31 I.L.M. 874, 877.

²⁶¹ GURUSWAMY & HENDRICKS, *supra* note 259, at 92.

²⁶² *Id.* at 92-93.

²⁶³ Edward O. Wilson, *Doomed to Early Demise*, UNESCO COURIER, May 1, 2000, at 22.

peared.²⁶⁴ “This time, however, human activity, not nature, is the culprit.”²⁶⁵ The cause of this crisis is human population increase coupled with the destruction of natural habitats, the invasion of alien species, and pollution.²⁶⁶ The CBD recognizes that in this era of mass extinctions, it is in our self-interest to preserve as much biodiversity as possible because “the loss of biodiversity threatens our food supplies, opportunities for recreation and tourism, and sources of wood, medicines and energy. It also interferes with essential ecological functions.”²⁶⁷ Moreover, scientists have only identified about 1.75 million of the estimated 13 million species that exist on earth, and the CBD is an attempt to preserve the unknown as well as the known.²⁶⁸

Coral reefs, one of the most diverse ecosystems on earth, also face mass extinction. This is not because of the usual “vagaries of weather and climate”²⁶⁹ such as hurricanes and other storms, which scientists now believe actually benefit ecosystems because they “prevent a few dominant species from pushing ‘inferior’ ones out.”²⁷⁰ As the distinguished biologist Edward O. Wilson notes, “in normal circumstances, the reefs recover from natural destruction within a few decades. But now these natural stresses are being augmented by human activity, and the coral banks are being steadily degraded with less chance for regeneration.”²⁷¹

For example, in looking at the reef off Florida’s Key Largo, Wilson discovered that thirty percent has been damaged since 1970, with the chief destructors being pollution, oil spills, “accidental grounding of freighters, dredging, mining for coral rock, and harvesting of the more attractive species for decoration and amateur collections.”²⁷² These sustained assaults on the health of a reef are different in kind from the brief, intermittent disturbances that occur naturally, and the prospect for reef survival in such areas is not good. Countries that have ratified the CBD are required to develop national biodiversity strategies and action plans,²⁷³ an integral part of which should be the prevention of further destruction of a nation’s coral reefs.

Even for countries that have not ratified the CBD, debt-for-nature swaps are one promising scheme for preserving biodiversity and promoting North-South relations.²⁷⁴ These swaps involve governments, or even

²⁶⁴ *Id.*

²⁶⁵ *Id.*

²⁶⁶ *Id.*

²⁶⁷ SECRETARIAT OF THE CBD, SUSTAINING LIFE ON EARTH 5 (2000), available at <http://www.biodiv.org/doc/publications/cbd-guide-en.pdf>.

²⁶⁸ *Id.*

²⁶⁹ EDWARD O. WILSON, THE DIVERSITY OF LIFE 270 (1992).

²⁷⁰ DAVIDSON, *supra* note 61, at 178.

²⁷¹ WILSON, *supra* note 269, at 270.

²⁷² *Id.*

²⁷³ CBD, *supra* note 245, art. 6, para. a, at 148.

²⁷⁴ See WILSON, *supra* note 269, at 337.

private organizations such as the Nature Conservancy and the World Wildlife Fund, purchasing a portion of a country's commercial debt in exchange for that country designating territory to be free from development or using the additional funds for environmental education or for the improvement of land management.²⁷⁵ The U.S. House of Representatives recently passed and sent to the Senate the Coral Reef and Coastal Marine Conservation Act to allow certain developing countries to honor their debts to the United States by starting coral reef conservation programs instead of by exploiting their natural resources to pay off the debt.²⁷⁶ One marine biologist believes this is a workable solution. "There is no reason that these arrangements cannot work for the marine realm as they have for tropical forests. Conserving the diversity of life in the sea calls for creative solutions that appeal to individual and national needs, as it does on land."²⁷⁷ Even though the United States has not ratified the CBD, some members of Congress are applying its principles to preserve coral reefs. The CBD recognizes the importance of balancing a nation's development needs with preserving its biodiversity, thus providing a framework for conserving essential biological resources for future generations.

D. Convention on International Trade in Endangered Species

While the United States is not yet a party to the CBD, it was the first state to ratify the Convention on International Trade in Endangered Species of Wild Flora and Fauna ("CITES") in 1973.²⁷⁸ CITES specifically addresses the problem of international trade in endangered species, including certain corals.²⁷⁹ The principal consumers of specific corals are aquarium hobbyists and "beach-side curio shops which sell pieces of dead coral as home decorations or jewelry."²⁸⁰ A monitoring organization reports that "[c]oral reef organisms are subjected to an increasing international trade Live and dead marine organisms are used for multiple purposes such as aquaria, swimming pools, decoration, souvenirs, jewelry and precious stones."²⁸¹ Recently, a study by TRAFFIC USA found that "Indonesia . . . supplies 95% of the world's coral trade, while the

²⁷⁵ *Id.* at 338.

²⁷⁶ H.R. 2272, 107th Cong. (2001).

²⁷⁷ Norse, *supra* note 67, at 218.

²⁷⁸ CITES, Mar. 3, 1973, 27 U.S.T. 1087, 1089, 993 U.N.T.S. 242, 244.

²⁷⁹ See *id.* arts. III-X, 27 U.S.T. at 1093-1104, 993 U.N.T.S. at 246-51; see also CITES Secretariat, *Appendices I and II*, available at http://www.cites.org/eng/append/1+II_0700.shtml (valid as of July 19, 2000) (listing *Antipatharia* (black corals), *Coenothecalia* (blue corals), *Scleractinia* (stony corals), *Milleporidae* spp., and *Stylasteriad* ssp. (fire corals)) (on file with the Harvard Environmental Law Review).

²⁸⁰ CITES, *supra* note 278, arts. III-X, 27 U.S.T. at 1093-1104, 993 U.N.T.S. at 246-51.

²⁸¹ TRAFFIC USA, *Legal Determination of Coral and Marine Organism Identification in the Netherlands*, at http://www.traffic.org/making-CITES-work/mcw_nl-coral.html (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

United States imports 85% of the dead coral and 98% of the live coral in the international trade.²⁸²

One hundred and fifty four nations have signed CITES,²⁸³ which provides varying degrees of protection to more than 30,000 plant and animal species.²⁸⁴ Member countries agree to ban commercial international trade in an agreed list of endangered species and to regulate and monitor trade in others that might become endangered.²⁸⁵ CITES entered into force in 1975, and the CITES Secretariat says that “[n]ot one species protected by CITES has become extinct as a result of trade since the Convention entered into force”²⁸⁶

CITES protects those species listed in the three appendices to the Convention.²⁸⁷ Any party to CITES may propose amendments to Appendices I and II, and to Appendix III if the named species is within that party’s jurisdiction.²⁸⁸ CITES forbids the trade in endangered species on the list in Appendix I except in extraordinary circumstances.²⁸⁹ The exporting and importing states must each certify that specific criteria have been met to ensure that the species is not further endangered.²⁹⁰

CITES authorizes the trade in species listed in Appendices II and III, subject to a permit system which allows states to monitor and even limit exports, if necessary.²⁹¹ In 1985, member nations of CITES listed all stony or reef-building corals on Appendix II as a response to the effect of the coral trade on reef ecosystems.²⁹² Now, black corals, blue corals, and antler coral are all listed in Appendix II of CITES²⁹³ and require a permit from the country of origin in order to be traded on the international market.²⁹⁴ There are approximately 230 species of coral listed by their common names on the CITES Species Database.²⁹⁵

²⁸² NOAA, *Reporter’s Coral Reef Tip Sheet*, at <http://www.publicaffairs.noaa.gov/iy-orwk22.html> (June 2, 1997) (on file with the Harvard Environmental Law Review).

²⁸³ CITES Secretariat, *Member Countries*, at <http://www.cites.org/eng/parties/index.shtml> (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

²⁸⁴ CITES Secretariat, *The CITES Species*, at <http://www.cites.org/eng/disc/species.shtml> (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

²⁸⁵ CITES Secretariat, *How CITES Works*, at <http://www.cites.org/eng/disc/how.shtml> (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

²⁸⁶ CITES Secretariat, *What is CITES?*, at http://www.cites.org/eng/disc/what_is.shtml (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

²⁸⁷ CITES, art. III, *supra* note 278, 27 U.S.T. 1087, 1093–98, 993 U.N.T.S. 242, 246–48.

²⁸⁸ *Id.* art. XV & XVI, 27 U.S.T. at 1110–14, 993 U.N.T.S. at 254–56.

²⁸⁹ *Id.* art. II, para. 1, 27 U.S.T. at 1092, 993 U.N.T.S. at 245.

²⁹⁰ *Id.* art. III, paras. 2–3, 27 U.S.T. at 1093, 993 U.N.T.S. at 246.

²⁹¹ *Id.* arts. IV–V, 27 U.S.T. at 1095–98, 993 U.N.T.S. at 247–48.

²⁹² U.S. Fish & Wildlife Service, *Coral Trade*, at <http://news.fws.gov/issues/coral.html> (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

²⁹³ CITES Secretariat, *supra* note 279.

²⁹⁴ CITES, *supra* note 278, art. IV, 27 U.S.T. at 1095, 993 U.N.T.S. at 247.

²⁹⁵ See UNEP-WCMC, *CITES-listed Species Database: Fauna*, at <http://www.cites.org/eng/resources/fauna.shtml> (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review). To access the information on listed coral species, search under “Common Name” for “Coral.”

Enforcement of the convention is not always successful. In some cases, "coral collected in countries where collection is illegal (such as the Philippines) is often exported and sold under the pretext of having been collected legally in a different country."²⁹⁶ Another problem is the difficulty of identifying the corals that are listed in the CITES appendices. For example, a CITES monitoring organization found that "the trade in corals and other marine organisms is increasing and there have been many instances where CITES-listed corals have been shipped without the necessary permits, or with incorrect permits, often resulting in sizeable confiscations."²⁹⁷ Part of the problem has been traders claiming that corals are "living rock" rather than "hard coral," and are thus exempt from the CITES permit requirements.

Since only specialists could differentiate between living rock and marine organisms such as corals, the CITES governing body adopted a resolution in April 2000 to include live rock in its definition of coral rock, thereby making the live rock subject to the Convention.²⁹⁸ Live rock is "pieces of coral rock to which are attached live specimens of invertebrate species and coralline algae not included in the CITES Appendices and which are transported moist, but not in water, in crates."²⁹⁹ The Convention does not apply to rock that does not contain any corals or in which the corals are fossilized.³⁰⁰ CITES is an evolving instrument and clarifications such as the above should be helpful for those officers in the field trying to enforce the Convention.

Another problem for reefs is that protection under CITES is not always broad enough. The United States, for example, bans the collection and export of coral from its reefs, but allows coral not covered by CITES to be imported from other regions such as Indonesia or Papua New Guinea where the reefs are also imperiled.³⁰¹ Moreover, CITES does not list many other reef species such as "puffer fish, seahorses, starfish, sea urchins, sea fans, sponges . . ."³⁰² These reef dwellers are an integral part of the coral reef ecosystem and the collection of them for souvenirs and private aquariums can be just as detrimental to the reefs as the collection of corals themselves.

CITES is useful for regulating the trade in discrete coral species, but it does not protect the entire ecosystem. Nonetheless, with effective enforcement and by raising public awareness about the need to purchase

²⁹⁶ Coral Reef Alliance, *Trade in Coral Reef Species*, at <http://www.coralreefalliance.org/aboutcoralreefs/trade.html> (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

²⁹⁷ TRAFFIC USA, *supra* note 281.

²⁹⁸ *Trade in Hard Corals*, CITES Res. 11.10, CITES Conference of the Parties, 11th Sess. (2000), available at <http://www.cites.org/eng/resols/EresVal3.doc>.

²⁹⁹ *Id.* at annex.

³⁰⁰ *Id.* at n.1.

³⁰¹ See, e.g., Coral Reef Alliance, *supra* note 296.

³⁰² *Id.*

only properly documented coral species, CITES is an effective tool to fight the destruction of coral reefs.

E. United Nations Convention Concerning the Protection of the World Cultural and Natural Heritage

The United Nations Convention Concerning the Protection of the World Cultural and Natural Heritage (“World Heritage Convention”) provides another means for protecting coral reefs.³⁰³ The Convention is under the auspice of the United Nations Educational, Scientific, and Cultural Organization (“UNESCO”). It notes that the world’s cultural and natural heritage is “increasingly threatened with destruction” and that the “deterioration or disappearance of any item of the cultural or natural heritage constitutes a harmful impoverishment of the heritage of all the nations of the world.”³⁰⁴ The Convention defines “natural heritage” as physical and biological formations of “outstanding universal value from the aesthetic or scientific point of view.”³⁰⁵ Under the Convention, an Intergovernmental Committee for the Protection of the Cultural and Natural Heritage of Outstanding Universal Value maintains a “World Heritage List” of property forming part of the cultural and natural heritage, with the consent of the state concerned.³⁰⁶ The Convention makes available a variety of technical and even financial assistance.³⁰⁷ This may include assistance in getting a site included on the World Heritage List, providing experts and others to help with the preservation of a listed site, or training staff and specialists in the identification and conservation of the cultural and natural heritage.³⁰⁸

There are 144 natural properties on the World Heritage List.³⁰⁹ Eleven of those sites contain coral reefs.³¹⁰ Three are in Australia, including the Great Barrier Reef, and two are in Indonesia.³¹¹ Belize, Mexico, the Philippines, the United States, the United Kingdom, and the Seychelles each have one site according to UNEP.³¹² However, the site listed in the United States, the Everglades National Park in Florida, only tan-

³⁰³ World Heritage Convention, Nov. 16, 1972, 27 U.S.T. 37, 1037 U.N.T.S. 151.

³⁰⁴ *Id.* pmbl., 27 U.S.T. at 40, 1037 U.N.T.S. at 152.

³⁰⁵ *Id.* art. 2, 27 U.S.T. at 41, 1037 U.N.T.S. at 153.

³⁰⁶ *See id.* arts. 8 & 11, 27 U.S.T. at 42–43, 1037 U.N.T.S. at 155–56.

³⁰⁷ *See id.* arts. 19–26, 27 U.S.T. at 46–47, 1037 U.N.T.S. at 159–60.

³⁰⁸ *See* UNESCO, *The World Heritage Fund*, at http://www.unesco.org/whc/ab_fund.htm (last modified Mar. 3, 2000) (on file with the Harvard Environmental Law Review).

³⁰⁹ *See* UNESCO, *The World Heritage List*, at <http://www.unesco.org/whc/heritage.htm> (last modified Dec. 16, 2001) (on file with the Harvard Environmental Law Review).

³¹⁰ UNEP-WCMC, A GLOBAL OVERVIEW OF WETLAND AND MARINE PROTECTED AREAS ON THE WORLD HERITAGE LIST tbl. 8 (Sept. 1997), available at <http://www.unep-wcmc.org/wh/reviews/wetlands/t8.htm> [hereinafter A GLOBAL OVERVIEW] (on file with the Harvard Environmental Law Review).

³¹¹ *Id.*

³¹² *Id.*

gentially touches the Florida reef system. In reality, UNESCO has not designated any coral reefs in the United States as World Heritage Sites. Designation as a World Heritage Site has benefited the Everglades Park through increased federal funding and the purchase of additional land to expand the park area.³¹³ Even with the World Heritage Site designation, increased funding and public awareness campaign, the fate of Everglades National Park is uncertain and the “biologic death” of the park is still possible.³¹⁴ Still there is some hope, thanks in part to the decision of the World Heritage Committee in 1993 to enter the Everglades on the List of World Heritage in Danger. This listing has not been a negative signal, as some seem to assume, but rather a rallying cry to the defense of sites facing real problems.

It is clear that World Heritage Site designation will not protect a site in the face of willful destruction such as the Taliban’s destruction of two giant Buddha statues in Afghanistan in 2001.³¹⁵ But for countries that do want to protect their cultural and natural heritage, World Heritage Site designation does provide a level of recognition, and even assistance, that can make the difference in saving that country’s heritage for future generations.

F. Conclusion

Much like the patchwork quality of the U.S. provisions, international treaties and conventions have provided protection, though not comprehensive, for marine ecosystems. These major international initiatives are summarized in Table 2.

³¹³ UNESCO, *Everglades National Park*, at <http://www.unesco.org/whc/sites/76.htm> (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

³¹⁴ *Everglades National Park/World Heritage Site, Two Anniversaries*, The World Heritage Newsletter (The World Heritage Center, UNESCO) Oct. 1997, available at <http://www.unesco.org/whc/news/12newsen.htm#story6> (noting a “93% decline in numbers of wading birds, 14 threatened or endangered species (63 in the region), the spread of invasive exotic species, mercury contamination in fish and predator species, the decline of Florida Bay as a productive estuary, replaced now by pea soup algae”).

³¹⁵ See Tina Rosenberg, *Destroying History’s Treasures*, N.Y. TIMES, Mar. 15, 2001, at A24.

TABLE 2. SUMMARY OF INTERNATIONAL PROVISIONS AFFECTING CORAL REEF CONSERVATION

Provision	Date	Scope of Provision	Terms of Provision	Effects on Coral Reefs
United Nations Convention Concerning the Protection of the World Cultural and Natural Heritage	1972	Natural and man-made properties of outstanding cultural, aesthetic, and scientific value	Provides technical and financial assistance for preservation of unique properties.	Ten World Heritage Sites contain coral reefs.
Convention on International Trade in Endangered Species ("CITES")	1973	Species listed as endangered	Bans trade in species listed in Appendix I and regulates, through permits, trade in species listed in Appendices II and III.	230 coral species listed in Appendices II and III.
United Nations Convention on the Law of the Sea ("UNCLOS")	1982	Ocean and its resources	General preservation of marine environment, conservation of marine species, and pollution reduction.	General protection of reefs of states that have entered the convention. Some consider UNCLOS customary international law.
Agenda 21	1992	Defines general rights and obligations between states and the environment	Calls for international cooperation and action to protect the environment.	Gives the protection of coral reefs high priority. Led to creation of the International Coral Reef Initiative.
Convention on Biological Diversity	1992	Ecosystems and habitats, species and communities	Framework treaty aiming to conserve biological diversity through monitoring, habitat preservation, establishment of protected areas, sustainable use of resources, and sharing of genetic resources.	Affects coral reefs because of their high biodiversity.

Meaningful international protection for oceans has only occurred in the last two decades. Most of the international agreements take an ecosystem approach, which is important for the long-term viability of coral reefs. The 1992 UNCLOS provides the most general protection for coral reefs through its requirement to preserve and protect marine environments. Agenda 21, adopted ten years later, built on UNCLOS and specifically identified coral reefs as an area of high priority and lead to the creation of ICRI, an international task force devoted to coral reef preservation. The World Heritage Convention has, to date, named eleven coral reefs as World Heritage Sites, leading to more domestic legal protection and sometimes financial and technical assistance from UNESCO. The CBD provides a framework for conserving coral reefs because of their high biological diversity. In addition to the ecosystem approaches in the conventions named above, CITES provides another level of protection for coral reefs by regulating the trade in various species of coral. Overall, the international provisions will prove valuable so long as there is the international will to abide by them.

VI. RECOMMENDATIONS FOR IMPROVING THE LEGAL PROTECTION OF CORAL REEFS

Coral reefs are not adequately protected currently, and they are rapidly disappearing. The following are recommendations for ensuring the long-term viability of the remaining reefs by altering human interaction with the reefs.

A. Establish No-Take Zones

An emerging practice in ocean management is to establish no-take zones that prohibit harvesting of marine resources. Efforts to control fisheries in the United States and elsewhere have traditionally involved regional management councils setting "restrictions on vessel size and power, total allowable catches, types of gear, time and area closures, and size and sex of the catch."³¹⁶ Currently, less than one percent of the continental shelf is set aside in no-take zones.³¹⁷ Some scientists believe that setting aside as much as twenty percent of the continental shelf as no-take zones is necessary to reestablish certain depleted fisheries.³¹⁸ Regeneration of fish populations will occur by allowing fish to mature, breed, and produce more eggs.³¹⁹ The goal of the no-take zones is "to make sure

³¹⁶ Sanchirico, *supra* note 181, at 1.

³¹⁷ Interview with James Bohnsack, *supra* note 44.

³¹⁸ *Id.*

³¹⁹ Unlike mammals, fish produce more eggs as they get older and larger. For example, a ten-year-old red snapper produces nine million eggs; but if the red snapper are caught when they are only two to four years old, it takes 212 red snapper to produce the same nine

enough of those fish grow large and breed to maintain the population. When these no-take zones are enforced, and the breeding grounds are given a rest, scientists see real benefits.³²⁰

Researchers are beginning to witness the success of no-take zones. In the Florida Keys National Marine Sanctuary, for example, managers set aside one percent of the sanctuary in 1997 as a no-take zone.³²¹ After the first full year of protection, the sanctuary no-take zones showed significantly more and larger lobsters, and the greatest numbers of certain economically important reef fishes in the sanctuary.³²² Scientists are also monitoring the response of corals within the no-take zones, but given their slow growth rate, their response to the changes is expected to take much longer.³²³ In addition to improving the health of the ecosystems within the no-take zones, marine scientists see spillover benefits outside the protected area, due to the complex biological links, particularly fish migrations, between protected and unprotected areas.³²⁴ The results are preliminary, but expanding the number of no-take zones and monitoring the results should be done quickly to see if the zones are as beneficial as anticipated.

B. Modify Fishing Practices

In lieu of banning all fishing in no-take zones, nations with coral reefs may also limit fishing methods to reduce the damage to fish stocks. Recently, the governor of American Samoa issued an executive order banning fishing while scuba diving in an effort to curb the serious problem of overfishing of reefs.³²⁵ Studies have shown that reef fish stocks off the main Island of Tutuila have dropped to a dangerously low level since the introduction of scuba fishing in 1994.³²⁶ Prior to 1994, one to three tons of parrotfish from reefs were caught annually; from 1994 to 1998, twenty-five to thirty-three tons of parrotfish were taken, with thirty-three

million eggs. *Id.*

³²⁰ *Id.* "In areas where enforcement has occurred, the benefits are observable." Interview with James Bohnsack, *supra* note 44.

³²¹ Press Release, Florida Keys National Marine Sanctuary, First-Year Results Show Sanctuary No-Take Zones Beginning to Change Fish and Lobster Populations (Mar. 4, 1999), at <http://www.fknms.nos.noaa.gov/tortugas/currentplans/pressrelease3499.html> (on file with the Harvard Environmental Law Review).

³²² *Id.*

³²³ *See id.*

³²⁴ *See* Sanchirico, *supra* note 181, at 5–6.

³²⁵ Exec. Order No. 002-2001, Apr. 6, 2001 (executive order by Tauese P.F. Sunia, Governor of Am. Sam., banning scuba fishing on reefs) (on file with the Harvard Environmental Law Review).

³²⁶ Posting of Andy Cornish, Chief Biologist, Dep't of Marine and Wildlife Service, Am. Sam., andy_cornish@yahoo.com, to coral-list-daily@coral.aoml.noaa.gov (Apr. 8, 2001) (on file with the Harvard Environmental Law Review).

tons representing one-fifth of the total biomass of parrotfish from the reefs fringing the island.³²⁷

In American Samoa, local communities believed the harm was caused principally by outsiders using scuba gear to fish their reefs, and “[t]his ecosystem approach to management was recognised by the communities as a valuable tool to aid recovery of depleted reef fish stocks.”³²⁸ Banning just one known, harmful method of fishing allows other, more sustainable fishing practices to continue and does not entirely cut off the livelihood of those who depend on the reef. At the same time, it permits the fisheries to replenish themselves.

C. Add Reef Species to CITES

CITES is another avenue for protecting creatures that live and depend on the reef. Currently under CITES, of all the non-fish and non-turtle species that live in coral reefs, only hard coral and giant clams are listed in Appendix II.³²⁹ Since parties to CITES are obligated to document and report on the quantity of trade in each species, the international community has a good idea of the magnitude of the legal international trade in those species. However, no marine ornamental fish or invertebrates typically found on reefs are covered by CITES.³³⁰ Therefore, any estimates of the extent of international trade in those species are simply guesses.³³¹ Since the over-harvesting of any one species in the reef ecosystem could upset the system’s balance, we need better data on the harvesting of all reef creatures in order to assess the harm accurately. Also, since the United States is currently considering adding elkhorn coral and staghorn coral to the ESA lists,³³² the CITES Conference of Parties should likewise consider affording those species the enhanced protection of Appendix I.

In 2000, UNEP established the WCMC to gather information on the sustainable use of the world’s living resources.³³³ The WCMC could be a valuable resource in determining the extent of the trade in ornamental fishes and other invertebrates from coral reefs. Since almost all marine

³²⁷ *Id.*

³²⁸ *Id.*

³²⁹ See CITES, *supra* note 278, app. II, 27 U.S.T. at 1132–43, 993 U.N.T.S. at 264–69; UNEP-WCMC, *Global Marine Aquarium Database, Background*, at <http://www.unep-wcmc.org/marine/GMAD/background.html> (last modified Jan. 14, 2002) (on file with the Harvard Environmental Law Review) [hereinafter *Global Marine Aquarium Database*].

³³⁰ See CITES, *supra* note 278, apps. I–III, 27 U.S.T. at 1118–43, 993 U.N.T.S. at 257–69; *Global Marine Aquarium Database*, *supra* note 329.

³³¹ See *Global Marine Aquarium Database*, *supra* note 329.

³³² See *supra* Section IV.E.

³³³ See UNEP-WCMC, *What UNEP-WCMC Does*, at <http://www.unep-wcmc.org/reception/does.htm> (last modified Nov. 7, 2001) (on file with the Harvard Environmental Law Review).

ornamentals pass through a relatively small number of wholesalers,³³⁴ the records of those businesses would be an excellent source of material on the marine ornamentals trade. Currently the reporting is voluntary,³³⁵ but an obligatory reporting regime would be invaluable.

D. Increase World Heritage Site Designations

Given the prediction that as much as sixty percent of the world's reefs will be gone in thirty years,³³⁶ UNESCO should expand the protection to reefs offered by the World Heritage Site designation. The World Heritage Committee could add the most endangered reefs to the List of World Heritage in Danger under Article 11.³³⁷

Article 11, paragraph four of the World Heritage Convention provides that property facing "threat of disappearance caused by accelerated deterioration, large-scale public or private projects or rapid urban or tourist development projects; destruction caused by changes in the use or ownership of the land; [or] major alterations due to unknown causes" may be included on the World Heritage List.³³⁸ The World Resources Institute estimates that twenty-five percent of all reefs in the world are at high risk of disappearance, with the reefs in Southeast Asia—"a global hot spot of coral and fish diversity"—most endangered, primarily from "coastal development, overfishing, and destructive fishing practices."³³⁹ Those reefs at high risk in Southeast Asia and elsewhere should be included on the World Heritage list. Under Articles 19 and 22, a party state containing a designated reef is eligible to request international assistance in the form of technical cooperation, loans, and even grants.³⁴⁰ These funds may be used in a variety of ways, ranging from training staff to providing experts, and even supplying equipment.³⁴¹

UNEP has already identified a number of coral reefs that it would like to see added to the World Heritage List, including reefs found in the Red Sea, Indonesia, and Fiji.³⁴² It should add to its list by incorporating the results of the international collaborative study titled "Reefs at Risk,"

³³⁴ *Global Marine Aquarium Database*, *supra* note 329.

³³⁵ See UNEP-WCMC, *Global Marine Aquarium Database, Description of GMAD*, at <http://www.unep-wcmc.org/marine/GMAD/description.html> (last modified Jan. 14, 2002) (on file with the Harvard Environmental Law Review).

³³⁶ Wilkinson, *supra* note 32, at 4.

³³⁷ World Heritage Convention, *supra* note 303, art. 11, para. 4, 27 U.S.T. at 43, 1037 U.N.T.S. at 156.

³³⁸ *Id.*

³³⁹ BRYANT ET AL., *supra* note 19, at 20–21.

³⁴⁰ World Heritage Convention, *supra* note 303, art. 19, para. 4, art. 22, 27 U.S.T. at 46–47, 1037 U.N.T.S. at 159–60.

³⁴¹ *Id.* art. 22, 27 U.S.T. at 47, 1037 U.N.T.S. at 160.

³⁴² See A GLOBAL OVERVIEW, *supra* note 310, at tbl. 11, available at <http://www.unep-wcmc.org/wh/reviews/wetlands/t11.htm> (on file with the Harvard Environmental Law Review).

which has classified the major reefs of the world in terms of their biodiversity and level of threat from human activity.³⁴³ UNESCO's World Heritage Program already highlights the threats to a variety of ecosystems.³⁴⁴ Given that coral reefs are the second most diverse ecosystem on the planet, UNESCO should give them equal priority.

E. Advance U.S. Practices

Domestically, the United States should immediately take action to foster the sustainable harvest of items imported from coral reefs. Although the United States forbids or strictly limits the extraction of hard corals in its own waters, it remains the single largest importer of coral and live rock.³⁴⁵ The United States could, in conjunction with exporting nations, help develop a certification program to reduce the amount of illegally obtained reef products imported into the country. For example, the United States could require certification that reef fish were not caught using cyanide or dynamite or that live coral and other organisms were not damaged in the harvesting process. Global efforts are already underway to tap into the "green" movement and ensure consumers that the ornamental fish they purchase did not involve harmful practices.³⁴⁶

President Clinton's designations of two coral reefs as national monuments should remain in place, but with more restrictions on their use, such as establishing no-take zones in portions of the monuments. Future presidents should also consider using the Antiquities Act to protect endangered coral reefs in U.S. waters. An executive order using the Antiquities Act will provide quicker protection for reefs. While such executive action may be reversed by subsequent presidents, even short-term protection could give a dying reef time to regrow and contribute to the longer time needed for the sanctuary designation process.

Congress has recently shown its willingness to protect coral reefs, but it needs to continue this trend with adequate implementation and funding. Congress's passage of the Coral Reef Conservation Act of 2000 was a good first step into an area that had received little congressional attention until the 1990s. But the Act is a limited grant-making program that provides no additional protection for the reefs. Congress needs to allocate the funding necessary to carry out the recommendations of the CRTF and its National Action Plan, including a budget for coral reef en-

³⁴³ See BRYANT ET AL., *supra* note 19.

³⁴⁴ See e.g., UNESCO, *Our Past, Our Future*, at <http://www.unesco.org/whc/nwhc/pages/sites/main.htm> (last visited Apr. 28, 2002) (on file with the Harvard Environmental Law Review).

³⁴⁵ See NATIONAL ACTION PLAN, *supra* note 180, at 30.

³⁴⁶ See, e.g., Marine Aquarium Council, *MAC Certification*, at <http://www.aquariumcouncil.org/subpage.asp?section=13> (last visited Apr. 28, 2001) (on file with the Harvard Environmental Law Review).

forcement. Given the low percentage of U.S. reefs that have been adequately mapped, it is also important to fund this endeavor of the CRTF now so that experts can effectively manage the reefs that remain. The United States should also implement the CRTF's recommendation of designating twenty percent of all U.S. coral reefs as no-take ecological reserves by 2010, at least for the limited time necessary to establish their efficacy. Without widespread support and lobbying by environmental groups, though, the actual percentage of no-take reserves will likely fall short of this figure. Congress can also take a global leadership position by passing the Coral Reef and Marine Conservation Act to allow countries to honor their debts to the United States by preserving their coral reefs from destructive uses.

Several Clinton proposals and executive orders should be continued during the current and subsequent administrations. The goal of Executive Order 13,089, to create a coordinated system of coral reef MPAs, is important and should be realized as soon as possible. Because of the interest in coral reefs generally, Congress's initial funding of the MPA project could be supplemented or replaced to protect and sustain our coral reefs by "user fees, subscriptions, support societies, volunteer organizations, etc."³⁴⁷

Finally, the United States, which became a global role model when it established the world's first national park on land in 1872 by creating Yellowstone National Park,³⁴⁸ could continue its role as a preservation leader by approving the Hawaiian Marine Sanctuary designated by President Clinton in December 2000.

VII. CONCLUSION

Coral reefs are a rare habitat, but one upon which millions of humans depend. Legal protection for coral reefs has begun relatively recently. In addition, existing protection consists of piecemeal laws and conventions that serve either directly or indirectly to protect only certain coral reefs. By all scientific accounts, coral reefs are at a crisis point, and their preservation requires more coordinated measures to protect these treasures both nationally and internationally.

The best hope for coral reefs so far seems to be in establishing more MPAs.³⁴⁹ Unfortunately, examples of MPAs are few. It is estimated that

³⁴⁷ Craig, *supra* note 169, at 10,364.

³⁴⁸ National Park Service, *Yellowstone National Park*, at <http://www.nps.gov/yell/> (last modified Mar. 12, 2002) (noting Yellowstone as the first national park in the world); *see also* National Park System, 16 U.S.C. § 16 1a-1 (2000) (recognizing Yellowstone as the first national park in the United States) (on file with the Harvard Environmental Law Review).

³⁴⁹ *See* Posting of Steven Miller, Director, National Undersea Research Center, University of North Carolina at Wilmington, skiller@gate.net, to coral-list-daily@coral.aoml.noaa.gov (Oct. 4, 2001) ("[W]hile it's uncertain what effect the MPAs will have on corals, we know that a result of protection will be more and larger fish, and increased numbers of

only three percent of the world's coral reefs are within MPAs, and at least forty countries have no legal protections for their reefs.³⁵⁰ The MPAs that do protect reefs tend to be very small, many of them only a square kilometer in size.³⁵¹ Only a few very large sites such as the Great Barrier Reef, the Florida Keys National Marine Sanctuary, and the Ras Moham-med Park Complex in Egypt are truly substantial MPAs.³⁵² Even designated MPAs may exist merely as "paper parks" where "legislation is not enforced, resources are lacking for protecting these areas, or management plans are poorly conceived."³⁵³

Edward O. Wilson has called for land-based reserves to be expanded from their current 4.3% of the earth's land surface to ten percent to prevent these fragments from becoming "shrunk habitat islands, whose faunas and floras will continue to dwindle until a new, often lower equilibrium is reached."³⁵⁴ The same argument applies to the oceans, and in particular, to coral reefs, those "rainforests of the sea" upon whose diversity so much life, human and otherwise, depends.

invertebrates This is the most important positive ACTION being done to protect coral reefs at local and regional scales.") (on file with the Harvard Environmental Law Review).

³⁵⁰ See BRYANT ET AL., *supra* note 19.

³⁵¹ *Id.*

³⁵² *Id.*

³⁵³ *Id.*

³⁵⁴ WILSON, *supra* note 269, at 337.